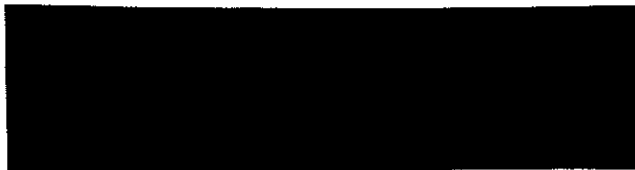


**PRELIMINARY REPORT OF  
RAINFALL EVENT, MAY 22-31, 1984  
LOWER EAST COAST**



**Water Resources Division  
Resource Planning Department**

**Operations Division  
Resource Operations Department**

**Field Engineering Division  
Resource Control Department**

**South Florida Water Management District**

**June 1984**



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## HYDROMETEOROLOGICAL ANALYSIS

### I. Description

The five days of virtually non-stop rain over the Memorial Day weekend (May 25-30, 1984) flooded streets, causing traffic jams in most of south Florida. Yet the constant downpour did not set any records.

The West Palm Beach Canal, the main artery that drains runoff from secondary canals in Loxahatchee, Royal Palm Beach, Wellington, Palm Springs, and West Palm Beach became overloaded and overtopped its banks in the western basin. Flooding of streets and yards was also reported in Jupiter Farms, Loxahatchee, the Village of Royal Palm Beach, Wellington, and Palm Springs; however, the flooding was not as severe as that of the October 22-24, 1983 storm.

Some minor flooding of streets and yards were also reported in Davie, Cooper City, Plantation Acres, North Lauderdale, and other west Broward cities. In the Miami area, more than a dozen local roads were closed because of high waters, and flooding of structures was reported in several of the older portions of the area. The new Miami metro rail was delayed an hour due to electrical problems at the Overtown Station.

Bob Rowlee, a forecaster for the National Weather Service, during an interview with the Sun-Sentinel News, said, "This (rain) is not normal--- but it certainly is not unusual. It's the start of the Florida rainy season." The rain was due to a series of cold front activities associated with moist tropical air moving continuously over the State of Florida, as high pressure in the Atlantic moved eastward and the upper air disturbance in the Gulf of Mexico moved northeastward. The move-

ment of these air masses began May 22. A series of National weather maps are included in Appendix A describing the following meteorological conditions:

1. Showers and thunderstorms that were developing along a slow moving cold front from the Great Lakes region across the Ohio Valley to Arkansas during the early hours of May 22.
2. Showers and thunderstorms were widely scattered over eastern Oklahoma and northern Texas. Other showers and thunderstorms covered southern Georgia and much of Florida.
3. On May 23 the cold front system moved eastward; moist tropical air was stationary over the State of Florida as high pressure in the Atlantic moved eastward.
4. An upper air disturbance in the Gulf of Mexico moved northeast across the State of Florida during the evening of May 23. The weakening cold front was almost stationary in that area, through May 25, with widely scattered heavy thunderstorms developing throughout the central and southern portion of Florida. The same system spawned thunderstorms in northern New Mexico, southern Colorado, and throughout the northern plains. Winds gusted up to 58 miles per hour (m.p.h.) in Alamosa, Colorado.

The second cold front began forming during the afternoon of May 25. Thick clouds, rain, and some thunderstorms were distributed along this cold front from the Great Lakes to the central plains. Some scattered showers and thunderstorms occurred during the night of May 25; the cold front extended from Maine southwest into eastern Texas. The evening showers and thunderstorms in the south Florida area intensified during May 26. Numerous heavy thunderstorms embedded in large patches of rain covered most of southeast Florida and the coastal waters during May 28.



The heaviest thunderstorms occurred over northern Broward and southern Palm Beach Counties, and over the Gulf Stream east of the upper Keys. The movement of the storm was in a northwest direction at 20 miles an hour; however, the weak low pressure area in the upper levels of the atmosphere (responsible for the increased thunderstorm activity) remained stationary. This caused the widely scattered showers and thunderstorms which continued into the evening over both the northern and southern Florida areas. The entire system, which did not leave the State of Florida until May 31, set a record low temperature of 61°F at Palm Beach International Airport.

It may be worthwhile to mention here that the same system caused severe flood damage to western Connecticut, Massachusetts, Pennsylvania, and northern New Jersey, and the floodwater forced 6,000 people to evacuate from their homes.

## II. Rainfall Distribution

As described previously, this rainstorm began May 22 and lasted through May 31. Heavy and intensive showers and thunderstorms were widely scattered over the entire central and southern portion of Florida. It is rather hard to pinpoint the rainfall distribution pattern in a time sequence unless a wide range of continuous rainfall records were analyzed. Unfortunately, it was not possible to do so at this time. Figures 1 and 2 present the daily rainfall values recorded at the following six rainfall stations in the lower east coast of Florida: S-5A, Loxahatchee, Pratt & Whitney, Palm Beach International Airport, Miami International Airport, and S-13 in Fort Lauderdale. Even though the hourly distribution of this rainstorm was not shown, the spatial and time variance of is visible. For example, the rainfall started on May 22

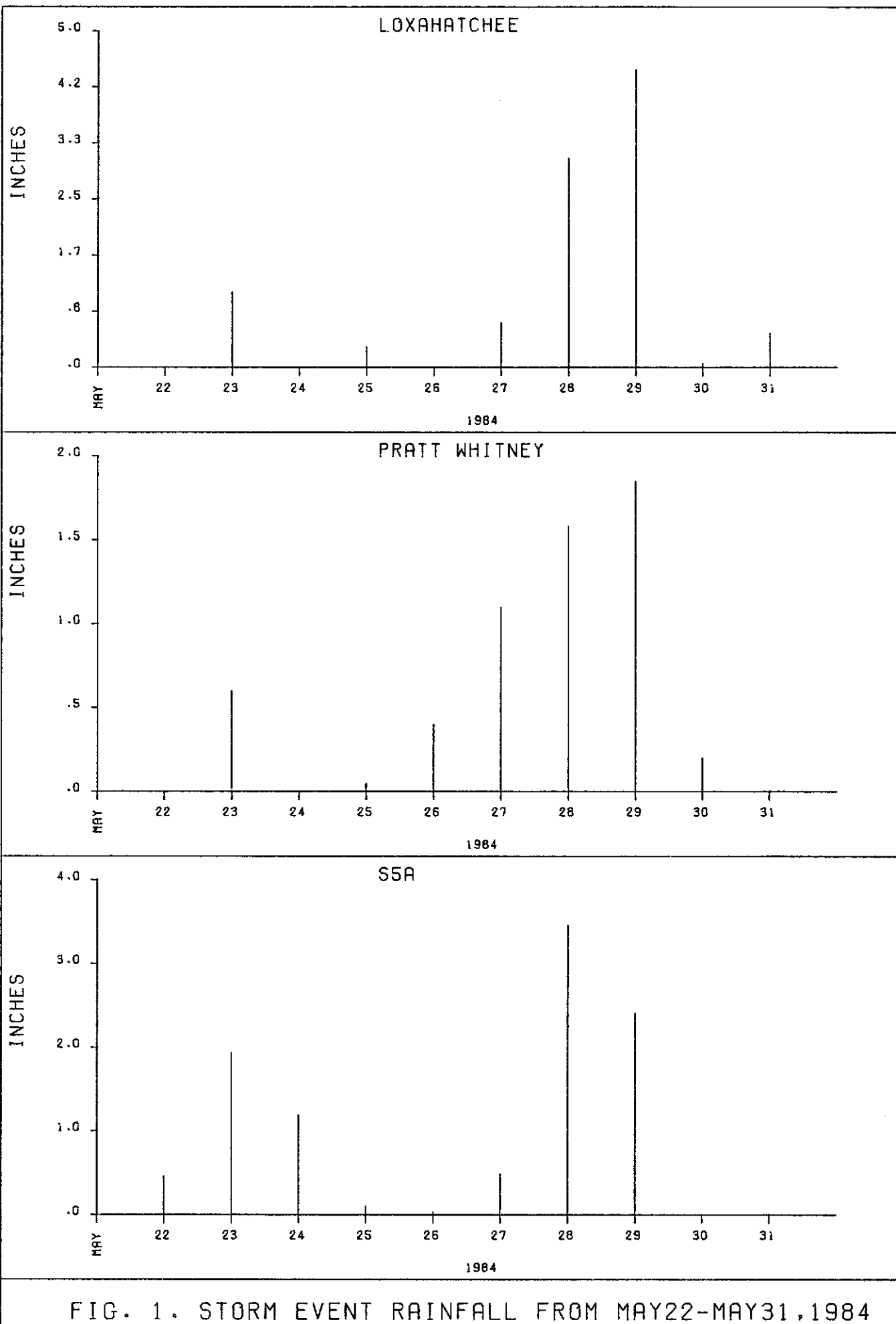


FIG. 1. STORM EVENT RAINFALL FROM MAY22-MAY31,1984

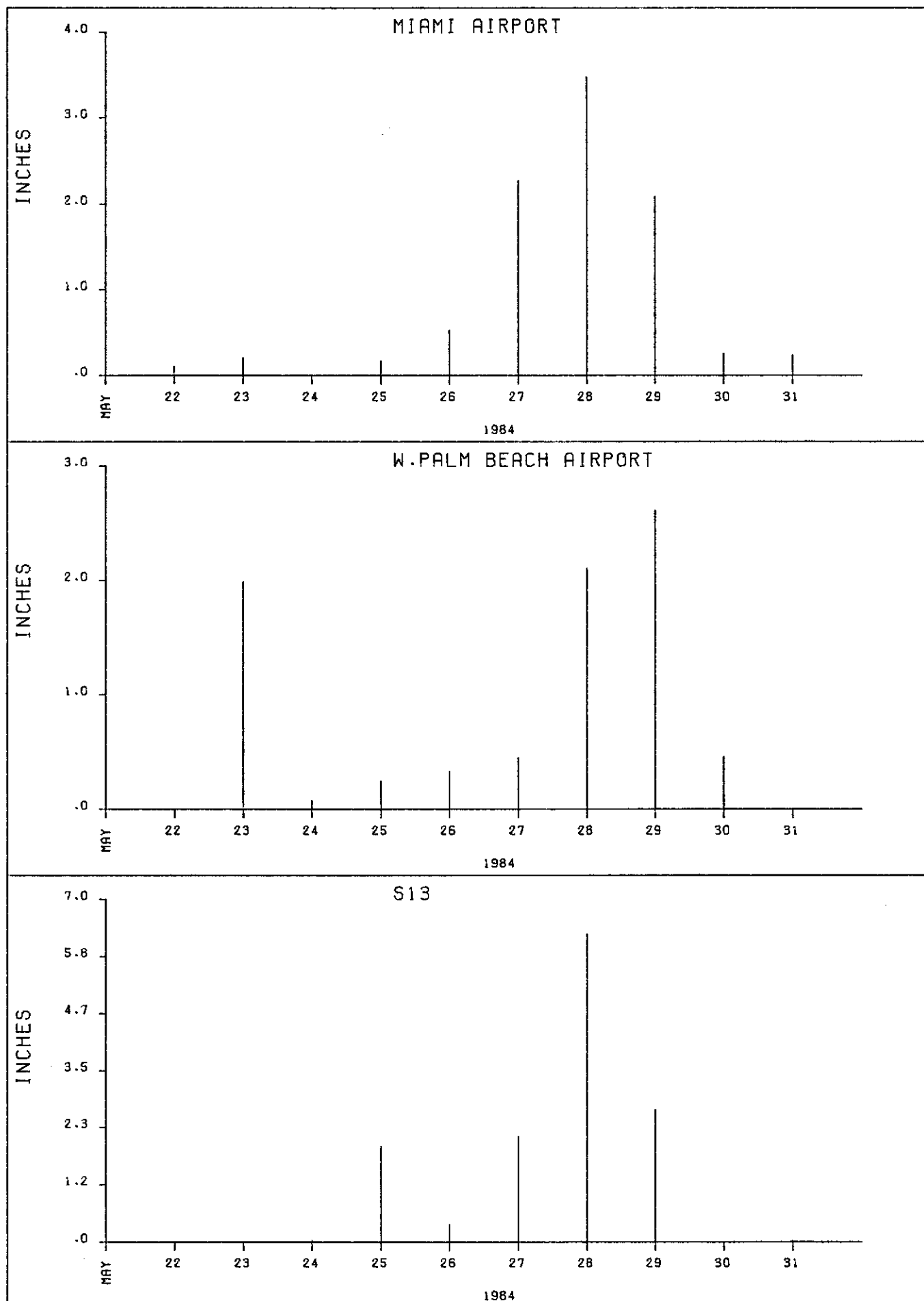


FIG. 2. STORM EVENT RAINFALL FROM MAY22-MAY31,1984

at S-5A (Water Conservation Area 1) and also at Miami International Airport. The rain did not begin until May 23 at Loxahatchee, Pratt & Whitney, and Palm Beach International Airport.

Due to the fact that many rain gages were not read until May 29 because of the Memorial Day weekend, and the different reading times for these nonrecording gages, the rainfall readings for this storm event were spread out from May 22 through May 31. Table 1 presents the daily rainfall values at available selected locations.

Figure 3 shows the isohyetal map of total rainfall distribution resulting from this rainstorm (10 days from May 22-31, 1984) in the lower east coast of Florida. A strip of land along the Florida Turnpike west of Boynton Beach, Delray Beach, and Boca Raton received the largest rainfall amounts of 14.0 to 18.0 inches. The area east of Water Conservation Area 1 (Area 1 included) and the eastern half of Water Conservation Area 2A received over 10.0 inches of rainfall. The western C-51 basin between State Road 7 (SR 7), S-5A, and the M canal, received 10.0 to 12.0 inches. Ft. Lauderdale and North Miami Beach received approximately the same amount of rainfall (10.0 to 12.0 inches). The area along U.S. Highway 1 between Coral Gables and Homestead received 10.0 to 11.0 inches. The eastern portion of the Everglades Agricultural Area received 6.0 to 10.0 inches, while the rest of the Everglades Agricultural Area received 4.0 to 5.0 inches. The area around Lake Okeechobee received from 2.50 to 5.0 inches. The Upper Kissimmee Lakes and the Kissimmee Valley received 2.0 to 8.0 inches of rain over this rainfall period. As a result of this rainstorm, the water levels in the Water Conservation Areas and Lake Okeechobee rose above their regulation schedules on May 29, except for WCA-3A. Table 2 presents the water

TABLE 1

## DAILY RAINFALL VALUES IN INCHES AT VARIOUS LOCATIONS

Station Name	<u>5/22</u>	<u>5/23</u>	<u>5/24</u>	<u>5/25</u>	<u>5/26</u>	<u>5/27</u>	<u>5/28</u>	<u>5/29</u>	<u>5/30</u>	<u>5/31</u>	Reading Time
<u>Upper and Lower East Coast</u>											
Port Mayaca	0.00	0.08	0.21	0.07	0.80	0.28	0.85	1.86	0.05	0.12	8 AM
Ft. Pierce F.S.	0.01	0.23	0.76	1.07	X	X	X	2.04A	0.03	0.10	7:25 AM
Stuart	0.22	0.90	0.15	0.39	0.13	0.17	3.30	2.01	3.15	0.12	4:00 PM
St. Lucie Lock	0.00	0.54	0.46	0.15	0.00	0.34	0.60	2.40	0.44	0.25	8:00 AM
Jupiter #1	0.00	0.60	0.60	0.20	0.13	2.45	1.50	3.45	1.65	0.35	8:00 AM
Jupiter Fire Sta.	0.05	1.64	0.17	0.03	0.36	0.20	1.28	2.52			
Pratt & Whitney	0.00	0.60	0.00	0.05	0.40	1.10	1.58	1.85	0.20	0.00	Midnight
4434 Fuscia Ct S (P.B. Gardens)	0.00	0.85	0.43	1.84	1.41	0.19	0.90	3.11	0.28	0.07	6:00 PM
Palm Beach Int'l Airport	T	1.99	0.08	0.25	0.33	0.45	2.11	2.61	0.46	T	
178 Drawdy Rd(WPB)	0.00	0.56	0.39	X	1.24A	1.26	2.93	3.96	0.18	0.30	6:00 PM
S-5A	0.46	1.94	1.19	0.10	0.04	0.49	3.46	2.41	M	M	Midnight
4444 Regency Dr (LW)	T	0.10	2.60	0.17	0.33	X	X	5.35A	1.15	0.57	8:00 AM
374 LaMancha Av. (RPB)	0.00	0.64	1.00	0.93	0.08	1.49	1.80	5.15	0.76	0.24	7:00 AM
Loxahatchee	0.00	1.12	0.00	0.31	0.00	0.67	3.11	4.43	0.06	0.51	5:00 PM
Greenacres City	0.02	0.17	2.50	0.17	X	X	X	10.02A	0.11	0.52	8 AM-Noon
Lake Worth Rd & El Canal	0.00	0.90	0.22	0.50	X	X	X	9.10A	0.16	0.87	8 AM-Noon
Boynton Rd. & Military Trail	0.00	0.22	1.52	0.08	X	X	X	8.00A	1.84	1.05	8 AM-Noon
Lat 32 & Rangeline	0.00	0.82	0.05	0.13	X	X	X	9.76A	2.15	1.48	8 AM-Noon
Delray Rd. & E2	0.00	1.15	0.63	0.06	X	X	X	11.05A	3.38	1.77	8 AM-Noon
Military & Lat 38 Lat 39 &	0.00	0.28	1.35	0.04	X	X	X	9.10A	0.62	0.11	8 AM-Noon
Rangeline	0.00	0.49	0.02	0.06	X	X	X	9.17A	1.84	0.11	8 AM-Noon
Boca Rd. & Rangeline	0.00	0.49	0.15	0.05	X	X	X	8.29A	1.18	0.13	8 AM-Noon
Boca Rd. & Powerline	0.00	0.20	0.93	0.03	X	X	X	13.95A	0.53	0.02	8 AM-Noon
Boynton Rd. & Military	0.00	0.22	1.52	0.08	X	X	X	8.00A	1.84	1.05	8 AM-Noon

Table 1 - continued

<u>Station Name</u>	<u>5/22</u>	<u>5/23</u>	<u>5/24</u>	<u>5/25</u>	<u>5/26</u>	<u>5/27</u>	<u>5/28</u>	<u>5/29</u>	<u>5/30</u>	<u>5/31</u>	<u>Reading Time</u>
Pompano Water Plant	0.32	0.06	1.62	0.01	0.01	2.18	4.92	3.75	0.08	T	Midnight
Ft.Laud./Dixie WP	0.00	0.07	0.33	0.07	0.12	0.55	3.70	3.18	0.90	0.18	5:00 PM
Gill Realty	0.00	0.05	0.08	0.06	X	X	X	9.36A	0.39	0.25	9:00 AM
Miami 12	0.00	0.04	0.10	0.06	0.51	X	4.15A	3.10	0.60	2.51	8:00 AM
Miami AP	0.11	0.21	0.00	0.17	0.53	2.27	3.48	2.09	0.26	0.24	8:00 AM
Callery Judge Groves (office)	-	-	-	-	0.20	0.60	1.50	5.50	0.10	0.00	Random
Miami Fld. Sta.	0.00	0.32	0.30	0.10	X	X	X	9.37A	0.60	0.65	7:00 AM
Homestead Exp.Sta.	0.00	0.06	0.01	0.08	0.80	4.80	0.40	1.58	0.05	1.09	9:00 AM
Homestead Fld.Sta	0.00	0.07	0.03	0.04	X	X	X	6.64A	1.42	1.86	6:30 AM
Royal Palm Rcher	0.02	0.09	0.13	0.00	2.10	4.49	1.17	0.21	0.29	1.20	2:00 PM
Ft.Laud.Fld.Sta.	0.00	0.13	0.10	0.08	X	X	5.08A	3.12	0.50	0.25	6:30 AM
Deerfield Lock	X	X	1.18A	X	X	X	6.83A	5.10	0.00	0.00	10-11 AM
S-36	0.28	1.48	0.02	0.06	0.00	1.35	3.49	2.01	0.02	0.00	Midnight
S-13	0.00	0.02	0.05	1.95	0.35	2.15	6.30	2.00E	0.00	0.03	Midnight
S-9	0.00	0.00	0.10	0.56	0.02	0.97	1.87	3.17	0.00	0.00	Midnight
3-26	0.00	0.00	0.02	0.00	0.00	3.70	4.90	0.42	0.04	0.00	Midnight
Gage 1-8	0.42	0.21	0.41	0.50	0.35	2.68	4.05	2.45	X	1.35A	Midnight
S-140	0.00	0.04	1.04	0.12	0.00	1.88	0.65	1.06	0.23	0.00	Midnight
S-20	0.00	0.00	0.00	0.00	0.00	1.79	1.13	0.59	2.63	0.17	Midnight
S-18C	0.00	0.00	0.00	0.44	0.00	3.45	1.05	2.40	0.53	0.36	Midnight
S-332	0.00	0.00	0.00	0.21	0.06	5.21	1.27	0.08	0.52	0.56	Midnight
S-336	0.14	0.23	0.13	0.30	0.13	3.82	1.85	0.25	0.73	0.82	Midnight
Flamingo	0.00	0.07	0.00	0.28	0.13	0.44	1.60	M	0.29	0.99	2:00 PM
<b><u>Everglades Agricultural Area</u></b>											
S-6	0.00	3.15	0.11	0.59	0.00	0.62	3.62	0.80	0.81	0.00	Midnight
S-7	0.00	0.00	0.60	0.92	0.00	1.21	2.51	1.79	0.98	-	Midnight
S-8	0.00	0.22	0.47	0.31	0.24	0.05	1.24	0.58	0.67	0.00	Midnight
S-2/HGS-4	0.00	0.00	0.90	0.52	X	X	X	3.40A	0.00	0.10	8:00 AM
S-3/HGS-3	0.00	0.00	0.96	0.55	X	X	X	2.85A	0.21	0.12	8:00 AM
S-4	0.00	0.00	1.35	1.47	X	X	X	2.32A	0.25	0.03	8:00 AM
Belle Glade	0.00	1.93	0.35	0.03	0.58	2.34	1.74	0.07	0.53	0.00	8:00 AM

Table 1 - continued

<u>Station Name</u>	<u>5/22</u>	<u>5/23</u>	<u>5/24</u>	<u>5/25</u>	<u>5/26</u>	<u>5/27</u>	<u>5/28</u>	<u>5/29</u>	<u>5/30</u>	<u>5/31</u>	<u>Time</u>
Canal Point	-	-	-	-	1.57	0.32	1.10	1.45	0.04	0.70	8:00 AM
La Belle	0.17	1.11	0.21	1.18	0.19	0.70	0.19	0.25	0.04	0.06	7-8:00 AM
Clewiston Field Station	0.00	0.00	1.91	0.33	X	X	X	2.61A	0.57	0.11	6:30 AM
<b><u>Upper Kissimmee Lakes and Kissimmee River Valley</u></b>											
Kissimmee Fld.Sta.	0.00	0.48	0.30	1.05	X	X	X	1.20A	0.19	0.00	7:30 AM
Brocks	0.00	0.80	1.59	0.61	X	X	X	1.16A	0.26	0.00	7:15 AM
S-61	0.00	0.55	0.39	0.91	X	X	X	0.73A	0.36	0.00	7:30 AM
S-65	0.10	0.86	1.14	0.67	X	X	X	2.80A	0.55	0.00	7:30 AM
S-65A	0.00	1.20	0.73	0.71	X	X	X	3.40A	1.11	0.00	7:30 AM
S-65B	1.07	0.26	1.16	2.53	0.43	0.71	0.89	1.23	0.00	0.00	Midnight
S-65C	0.00	0.50	0.51	0.35	X	X	X	4.15A	0.30	0.00	7:30 AM
S-65D	0.39	0.19	0.07	0.78	0.09	0.94	0.10	0.57	0.18	0.00	Midnight
S-65E	0.00	0.12	0.10	0.21	X	X	X	1.31A	0.05	0.06	7:30 AM
S-68	0.00	0.30	1.45	1.10	X	X	X	2.15A	T	0.00	7:30 AM
Okeechobee Fld.Sta	0.08	0.34	0.06	1.42	X	X	X	4.36A	0.05	0.00	7:30 AM
<b><u>Lower West Coast</u></b>											
Ortona Lock	0.00	0.50	0.00	2.60	0.08	0.35	0.15	0.55	0.00	0.00	8:00 AM
Moorehaven Lock	0.00	0.19	0.05	1.36	0.00	0.56	1.32	0.59	0.30	0.04	8:00 AM
Oasis	0.00	1.69	0.03	1.19	0.23	1.24	0.55	0.09	0.11	0.00	2:00 PM
Ft. Myers	0.34	0.01	0.01	0.32	0.18	0.00	T	0.54	0.03	0.00	Midnight
Alva Farms	0.40	0.05	2.15	0.22	1.90	0.06	0.15	0.18	0.05	0.00	7:30 AM
S-127	0.00	0.10	0.10	1.35	X	X	X	1.90A	0.05	0.05	7:30 AM
S-129	0.00	0.15	0.12	0.80	X	X	X	1.20A	0.08	0.05	7:30 AM
S-131	0.00	0.20	0.15	1.20	X	X	X	3.25A	0.00	0.07	7:30 AM

NOTES: X: Accumulated on the following date

A: Accumulation

-: No information

T: Trace

M: Missing

E: Estimated

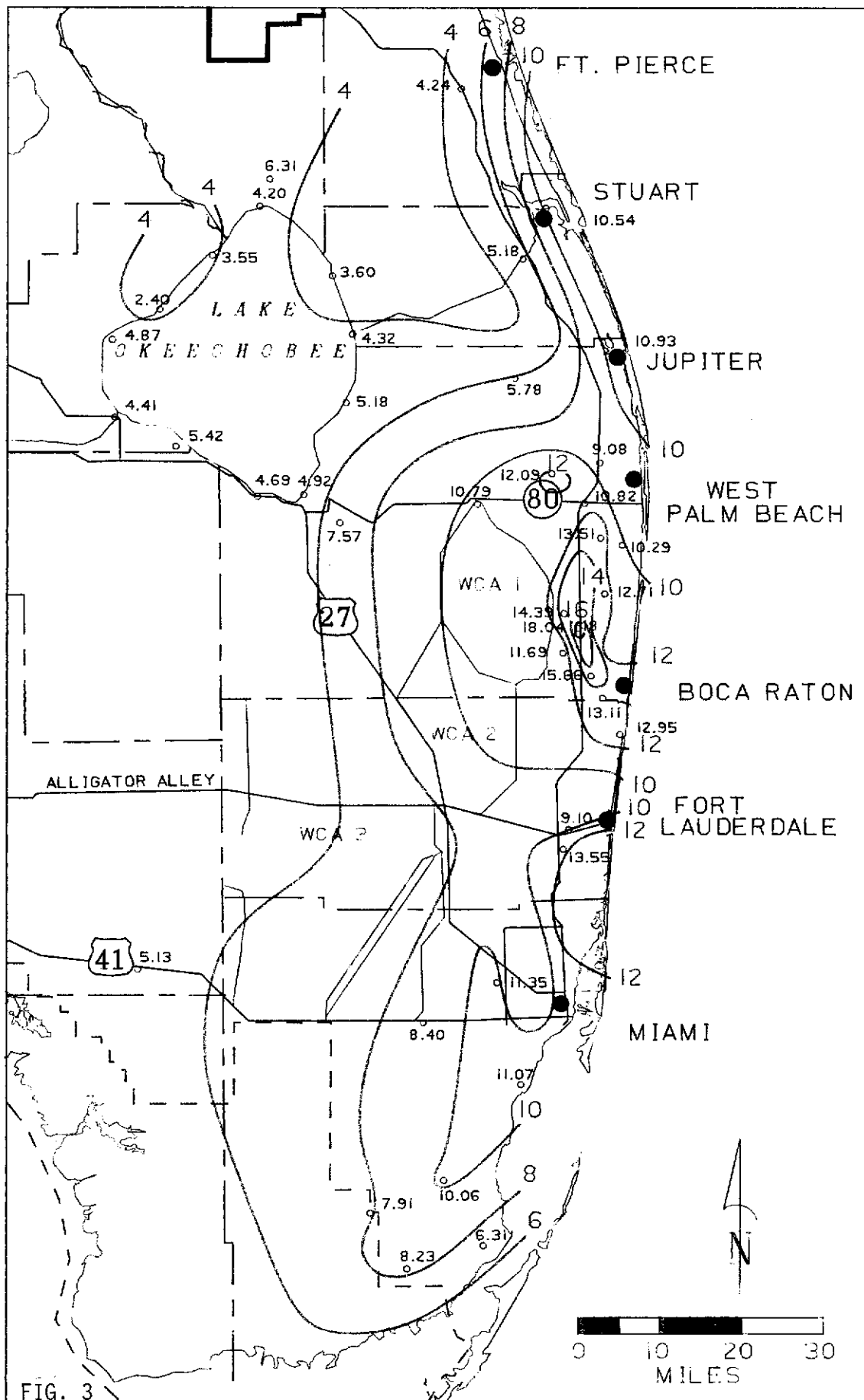


FIG. 3

10 DAYS TOTAL RAINFALL (MAY 22-31, 1984)  
SOUTHEASTERN FLORIDA (INCHES)



TABLE 2

**WATER LEVELS IN WATER CONSERVATION AREAS AND  
LAKE OKEECHOBEE BASED ON DAILY WATER READINGS  
(AT 8 A.M.)**

<u>Date</u>	<u>WCA-1</u>	<u>WCA-2A</u>	<u>WCA-3A</u>	<u>Okeechobee</u>
5/21/84	11.10	11.27	8.77	15.38
5/22/84	11.00	11.25	8.75	15.33
5/23/84	11.14	11.24	8.73	15.30
5/24/84	13.30	11.23	8.75	15.35
5/25/84	14.32	11.26	8.76	15.40
5/26/84	N/A	N/A	N/A	N/A
5/27/84	N/A	N/A	N/A	N/A
5/28/84	N/A	N/A	NA	N/A
5/29/84	15.81	11.95	9.15	15.65
5/30/84	16.00	11.88	9.18	15.80
5/31/84	16.06	11.87	9.22	15.72
6/1/84	16.05	11.84	9.23	15.72

levels in the Water Conservation Areas and Lake Okeechobee. Figure 4 presents a copy of water conditions of the Central and Southern Florida Flood Control Project as of May 29, prepared by the U. S. Army Corps of Engineers, Jacksonville District, Florida. The pumping stations around the Water Conservation Areas were pumping runoff into the Water Conservation Areas and S-2 was pumping local runoff from the Hillsboro Canal basin into Lake Okeechobee. Lake Okeechobee stage exceeded its regulation schedule and began its regulatory releases through the Caloosahatchee River to the Gulf of Mexico.

To evaluate the return frequency of the rainfall associated with this storm event, the maximum 1-day, 3-day, and 5-day rainfall map series presented in the "Frequency Analysis of Rainfall Maximums for Central and South Florida", District Technical Publication 81-3, were used. Even though this rainstorm lasted for about ten days, most of the rainfall occurred between May 26 through May 30; therefore, the total rainfall of five consecutive days were computed for each selected location.

Figure 5 presents the isohyetal map of the 5-day rainfall distribution over the lower east coast of Florida. The areas of high rainfall concentration were approximately the same as the one for 10 days of rainfall distribution.

The strip of land along the Florida Turnpike west of Delray Beach and Boca Raton received the highest amount (12.0 to 14.48 inches) of rain over this 5-day period. This 5-day rainfall amount is equivalent to 1 in 10-year return frequency for the area.

The western C-51 basin received 7.0 to 9.6 inches in the 5-day period equivalent to a 1 in 5-year return period.

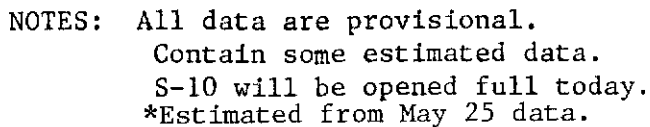


FIG. 4 WATER CONDITIONS C S & F PROJECT AS OF 05/29/84

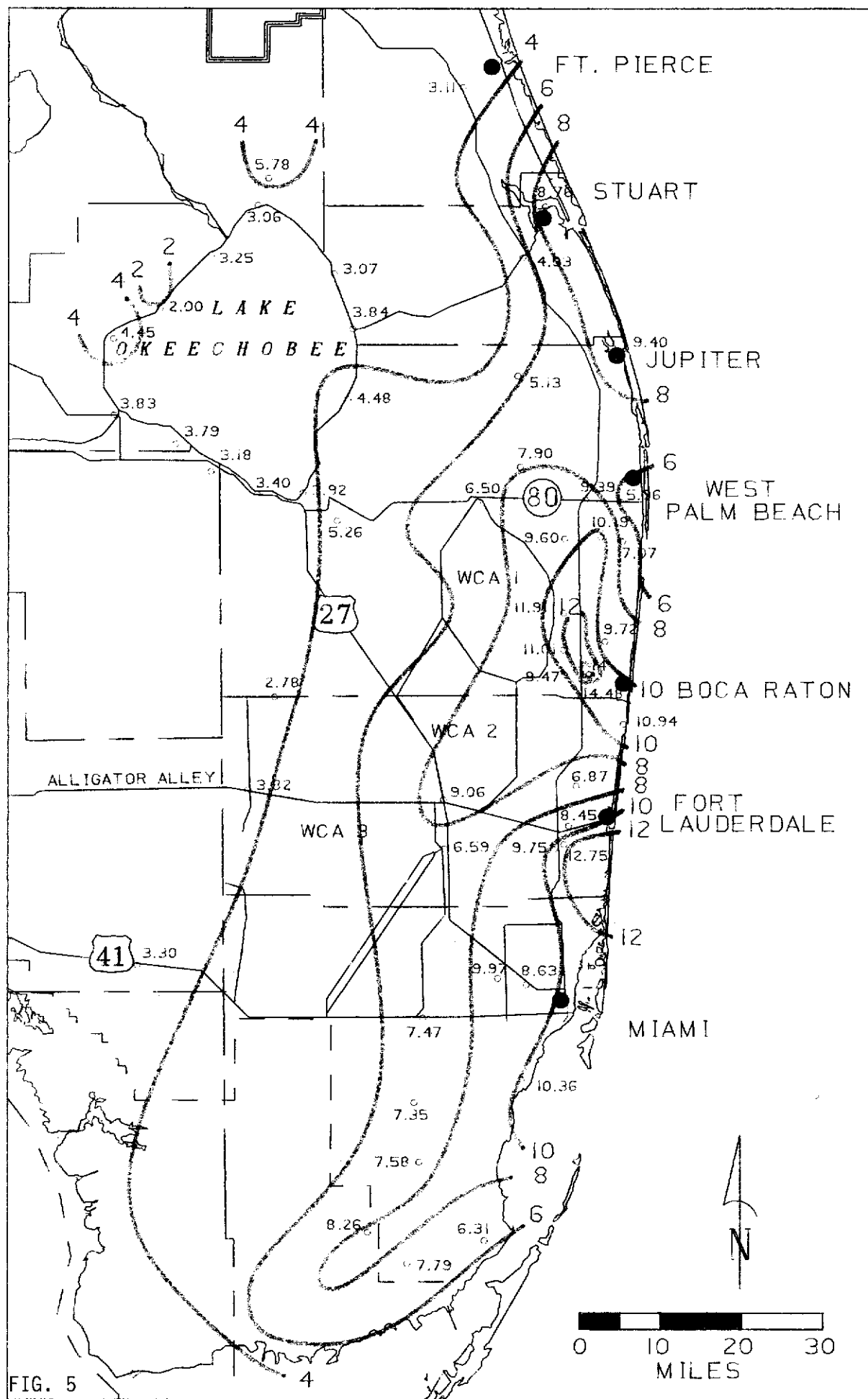


FIG. 5  
5 DAYS TOTAL RAINFALL (MAY 26-30, 1984)  
SOUTHEASTERN FLORIDA (UNIT IN INCHES)

The eastern C-51 basin received 6.0 to 9.0 inches of rain in this 5-day period equivalent to 1 in 3 years or less return frequency.

The Ft. Lauderdale and Hollywood area received about 10.0 to 12.0 inches of rain in five days which is equivalent to 1 in 5 to 10 years return period.

The eastern portion of Miami and the entire Miami Beach area received an equivalent of 1 in 5 years return for a 5-day rainfall. The rest of the area received lesser rainfall amounts and were in the order of 1 in 3 years or less return period.

### III. Antecedent Conditions

#### A. Rainfall

Prior to the beginning of the rainstorm on May 22 the entire State of Florida had experienced a dry spell with very little or no rainfall in the preceding weeks. On May 18-19, a forest fire engulfed more than 7,000 acres of prime timber in rural Taylor County about 50 miles east of Tallahassee. On May 21 a brush fire also burned approximately 400 acres of land in Loxahatchee (Palm Beach County) west of Seminole-Pratt Whitney Road due to the dry conditions that had prevailed since mid-April.

Figure 6 presents the isohyetal map of the total rainfall for May 1984. When compared to Figure 3, it is apparent that the rainfall in the last ten days of May made up over 90 percent of the total rainfall in the area. Figure 7 shows the isohyetal map for normal rainfall in May. The amount of rainfall in the Lower East Coast area was between 100 to 200 percent of normal during this 10-day period. The flooding in the area would have been worse if the antecedent conditions had been as wet as those which preceded the rainstorm that occurred in Palm Beach County on October 22-24, 1983.

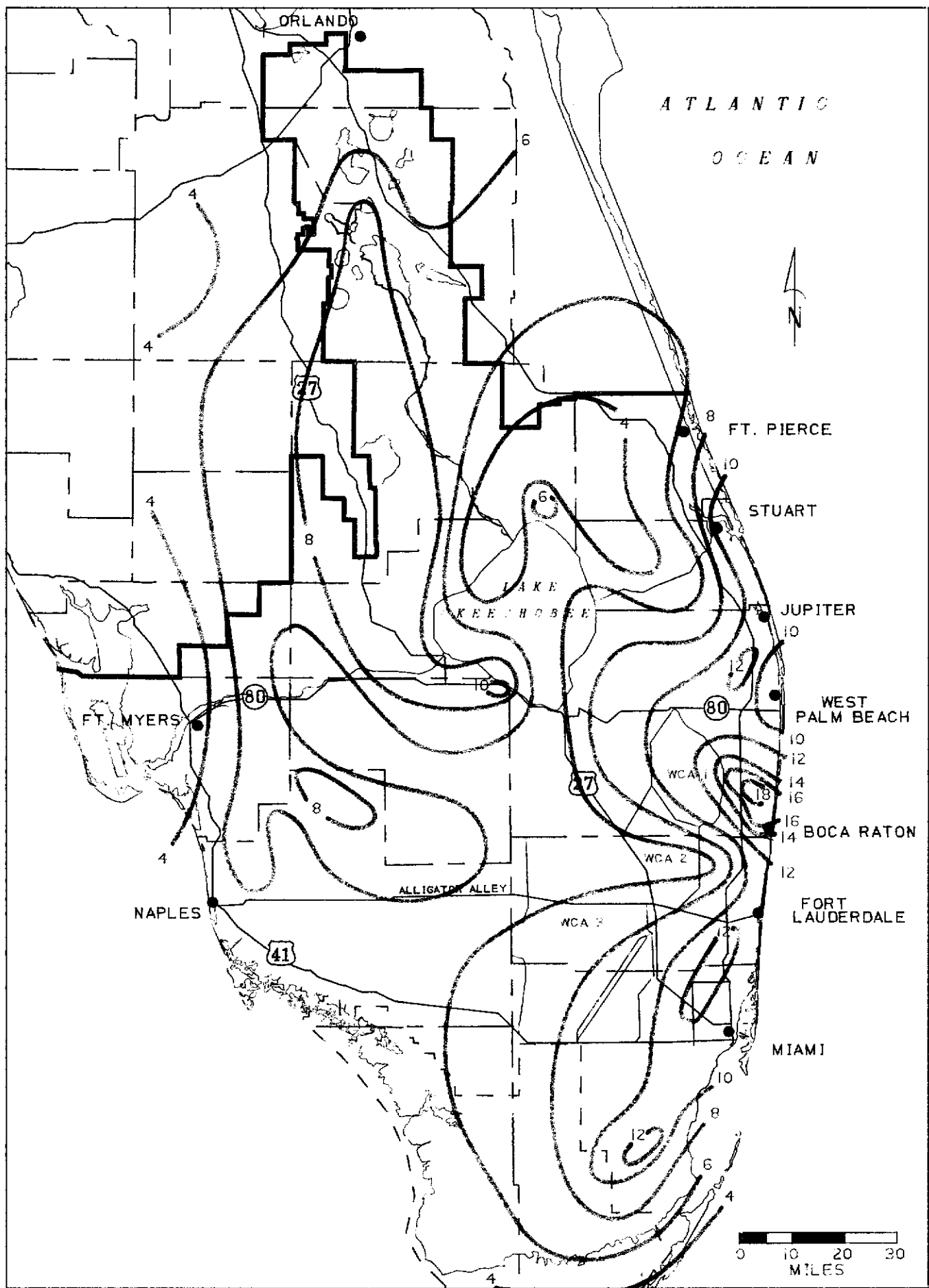


FIG. 6

RAINFALL - MAY, 1984 (INCHES)

B. Canal Stages Prior to the Storm

Since the greatest amount of rainfall occurred in the south-eastern portion of the District, the water level conditions in this area were examined. The following table (3) presents the water levels on May 21 as compared to their optimum stages.

TABLE 3  
WATER LEVELS ON MAY 21, 1984, AS COMPARED TO THEIR  
OPTIMUM STAGES

<u>Structure</u>	<u>May 21, 1984 Headwater Stage (Hour 1300) ft NGVD</u>	<u>Current Optimum Stage - ft NGVD</u>	<u>Normal Optimum Stage - ft NGVD</u>
S-40	7.35	7.50	8.50
S-41	7.66	7.50	8.50
S-44	7.14	7.00	6.80-7.30
S-155	7.73	8.20	8.50
L-8 @ SR441	10.67	12.00	12.00
S-13A HW	3.43	3.50	4.50
S-13A TW	1.91	2.00	2.50
S-36 HW	2.49	4.60	5.00
S-16C HW	0.83	2.30	1.80-2.30
S-20F HW	1.25	2.00	2.00
S-21 HW	1.56	1.90	1.50-1.90
S-26 HW	2.64	2.70	2.70
S-27 HW	1.63	1.70	1.70
S-29 HW	2.03	2.30	2.30

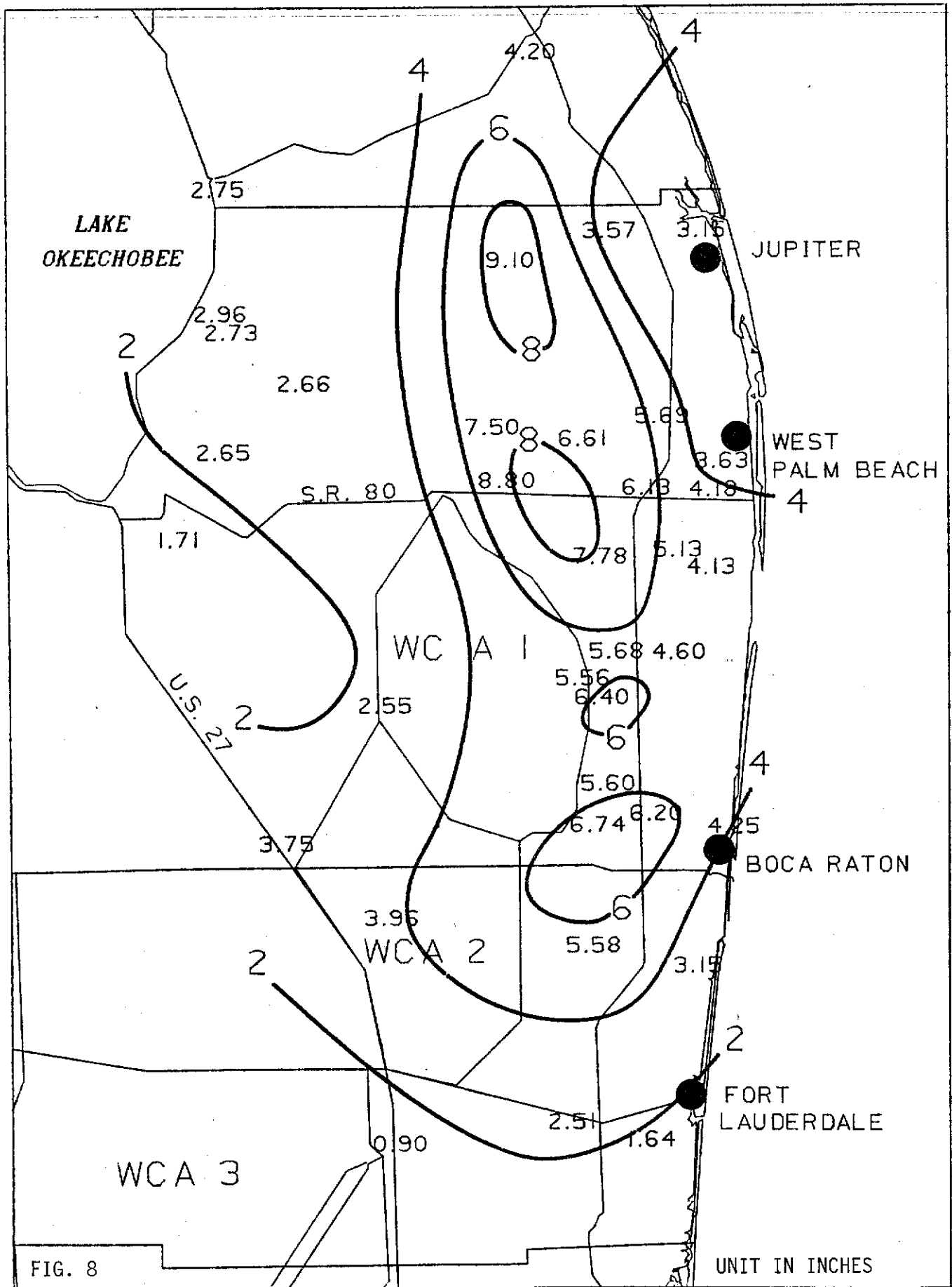
The water levels in most of the areas were held at or slightly below their current optimum levels due to the dry conditions prior to this rainstorm.

#### **IV. Rainfall Comparisons**

As indicated by Mr. Rowlee this rainfall event was not normal, but not unusual either. No record was set by this rainstorm. The periods of 10-day rainfalls which exceeded 10.0 inches at Loxahatchee, Palm Beach International Airport, Ft. Lauderdale, and the Miami International Airport were examined and compared with the current event. The comparison supports Mr. Rowlee's assessment on this rainfall event. Appendix B presents those rainfall periods at four stations as compared to the current event.

Figure 8 presents the isohyetal map of the October 22-24, 1983 storm in Palm Beach County. A general comparison indicated that a greater amount of rainfall was received in the C-51 canal basin from this event than from the October 1983 event. It is important to point out that the rainfall distribution shown for the October 22-24, 1983 storm was for two days instead of five to ten days for the current event. The 10-day rainfall recorded at Loxahatchee was 12.11 inches for October 16-25, 1983 with 8.80 inches on October 22-23, while the total 10-day rainfall from this event was 10.21 inches with 7.54 inches recorded for May 28-29, 1984; therefore, the intensity and total of the rainfall recorded at Loxahatchee was slightly less for the current event than for the October 1983 event. This explains why the flooding conditions in the western C-51 canal basin were less severe under the current event than during the October 1983 event, and the stage in the West Palm Beach Canal was high and overflowed its bank at a spot approximately 0.9 miles east of S-5A.





ISOHYETAL MAP OF OCTOBER 22-24, 1983 STORM  
IN MARTIN, PALM BEACH AND BROWARD COUNTIES

## OPERATION OF THE SYSTEM

### I. Homestead Area

The system was operated properly. All canal stages were within their operational range. Figure 9 presents the hourly stage hydrograph at S-18C headwater during this rainstorm. The stage was slightly above the normal optimum of 2.30 ft NGVD; however, the critical stage of 2.80 ft was not reached during this rainstorm. This critical stage is defined as a stage which will not cause any adverse backwater effect to the upstream area. Detailed information on the operation of the south Dade conveyance system during this event is presented in Table 4.

TABLE 4  
COMPILATION OF SYSTEM OPERATION IN HOMESTEAD AREA

<u>Structure</u>	<u>Location</u>	<u>Mode of Operation</u>	<u>Structure Operated</u>		<u>Remarks</u>
			<u>Time</u>	<u>Date</u>	
S-18C	C-111	Automatic	1200	5/27/84	Open full Divided structure
S-173	L-31N	Manual	1140	5/27/84	Closed
S-175	L-31W	Manual	1340	5/27/84	Open full
S-176	C-111	Automatic	0925	5/28/84	Open full
S-177	C-111	Automatic	1450	5/2784	Open full
S-178	C-111E	Manual	1440	5/27/84	No. 1 gate open
S-179	C-103	Automatic	1015	5/27/84	No. 2 gate closed
S-194	C-102	Manual	1420	5/27/84	Set at automatic
S-197	C-111	Manual	1200	5/28/84	Open full

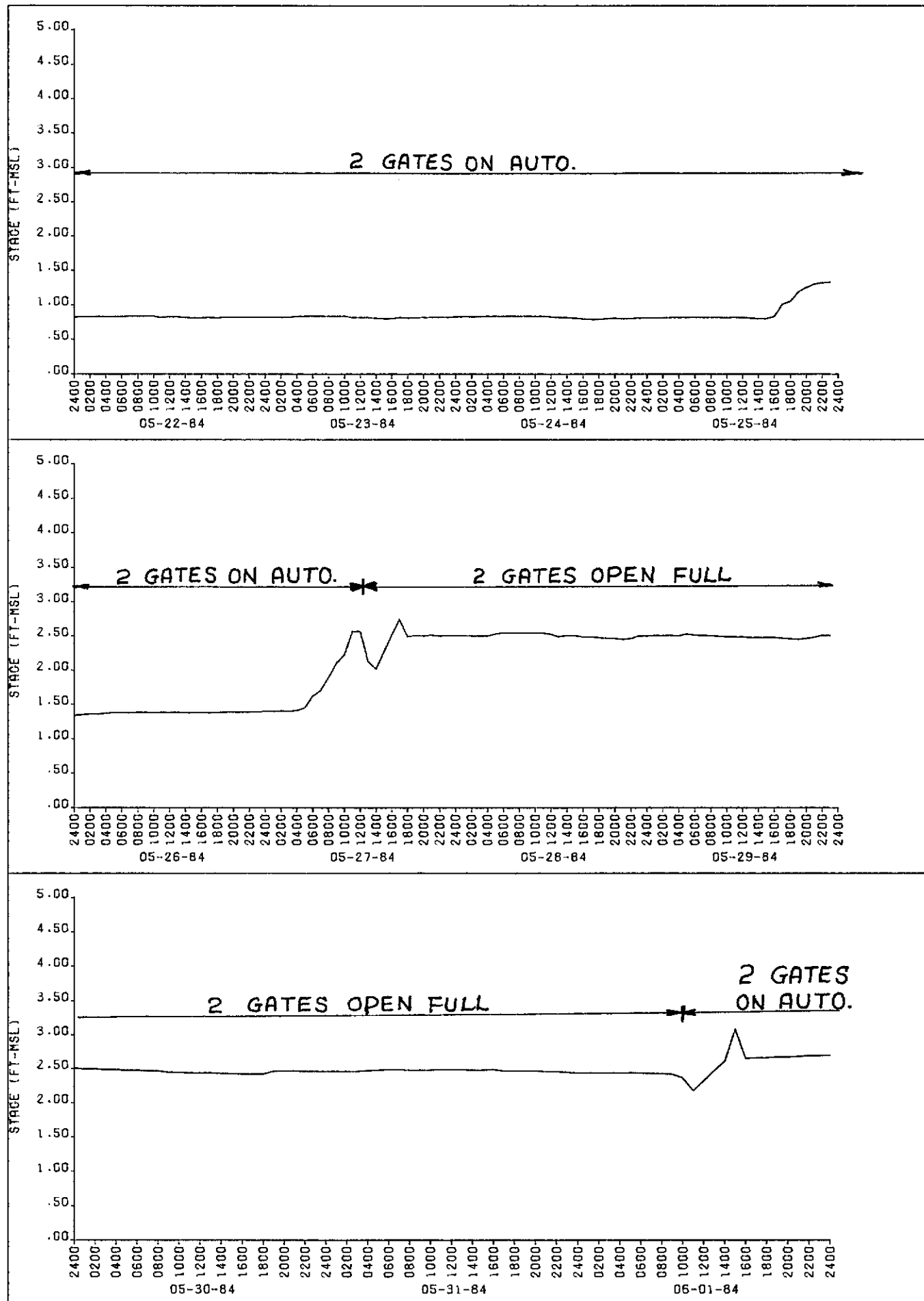


FIG. 9 HOURLY STAGE READINGS AT S-18C HW

## II. Miami Area

During the flood period, all the coastal structures were opened and discharged the maximum flow. Some of the canals still experienced high stages due to the system limitations and high tide. Figure 10 presents the hourly stage hydrograph at the headwaters of S-26 during this rainstorm. The highest stage at S-26 headwater was 3.02 ft NGVD at 8 a.m., May 29; the backwater stage at S-31 tailwater was 4.28 ft NGVD. Table 5 presents a detailed description of the operation of selected coastal structures in Dade County.

TABLE 5  
COMPILATION OF SYSTEM OPERATION IN THE MIAMI AREA

<u>Structure</u>	<u>Location</u>	<u>Mode of Operation</u>	<u>Structure Operated</u>		<u>Remarks</u>
			<u>Time</u>	<u>Date</u>	
G-58	Arch Creek	Manual	1230	5/28/84	2 gates at 6'
G-97	Coral Gables Canal	Manual	2030	5/28/84	6 needles removed
S-25B	C-4	Automatic	1700	5/28/84	Open full
S-26	C-6	Automatic	1700	5/28/84	#1 gate at 8' #2 gate at 5'
S-27	C-7	Automatic	1200	5/28/84	Open full
S-28	C-8	Automatic	1200	5/28/84	Open full
S-29	C-9	Automatic	1200	5/28/84	Open full
S-22	C-2	Automatic	1700	5/28/84	2 gates at 5'

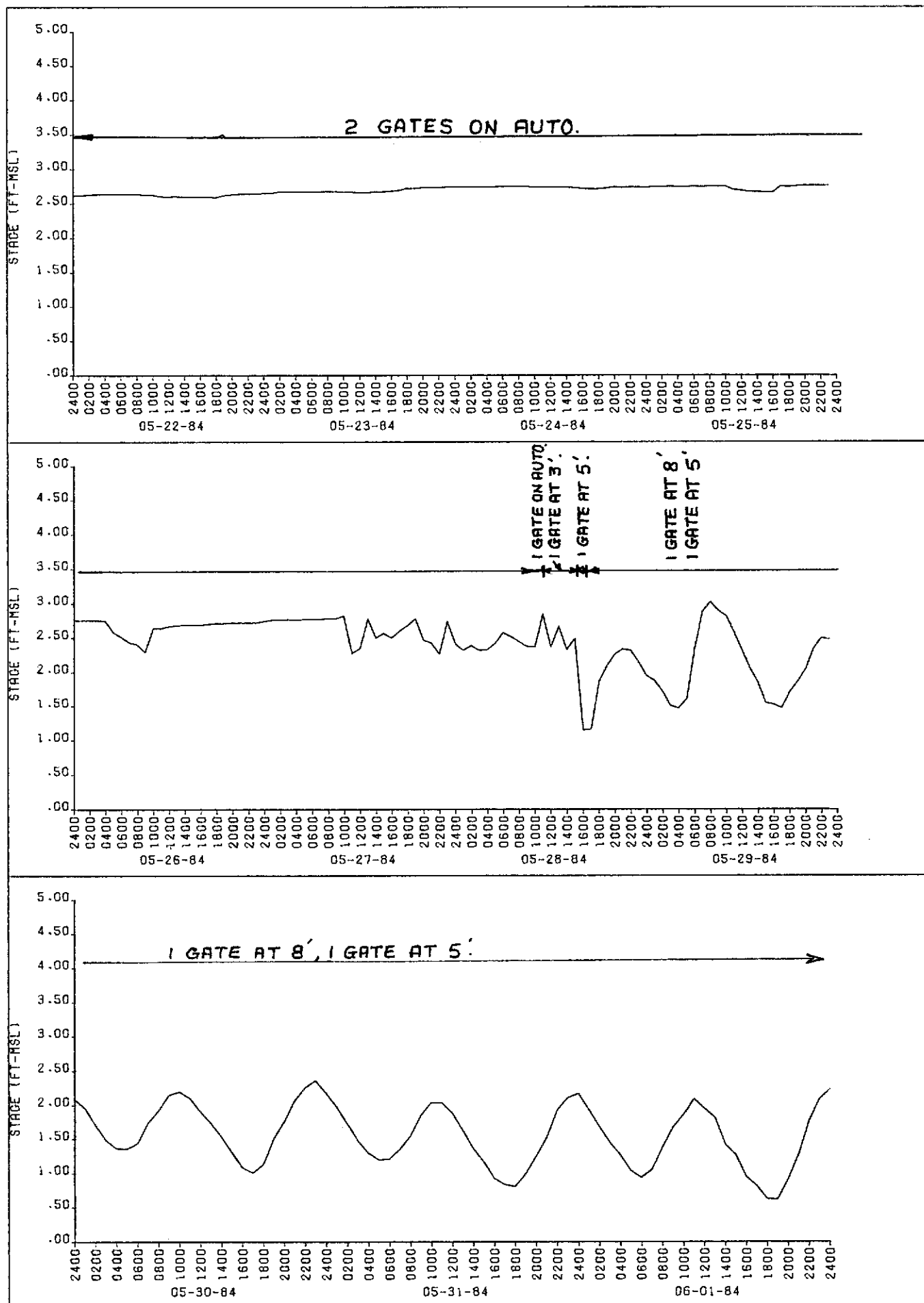


FIG. 10 HOURLY STAGE READINGS AT S-26 HW

### III. Palm Beach Area

During the storm period, water stages in the District canals were lowered to facilitate the secondary drainage system. In the C-51, the recently completed S-155 was opened to lower the headwater stage 1 ft below its optimum level of 8.5 ft NGVD, the western C-51 canal basin still flowed over its south bank and discharged into the Sucrose Grower area as it did in October 22-24, 1983, due to the system in this reach being overloaded. In the 1983 storm, S-5AE gates were fully open before the storm and S-5AW gates were opened shortly after the S-5A pumps were in operation to relieve flooding in the western C-51. During this storm, the EAA and the L-8 basin received more than twice the amount of rainfall than during the 1983 storm. The S-5A pump station can only drain the runoff from the EAA; S-5A(E) and S-5A(W) were opened on May 31, 1984, when the canal stage in the EAA receded.

Because of the large amount of discharge through the new S-155 structure on the morning of May 30, erosion was found around the north bank of the site when a contractor removed the old Palm Beach Lock. The gates at S-155 were reduced to a 3 ft opening in order to prevent damage to private property.

The operation of the water control structures along the West Palm Beach Canal, and their hourly stage hydrographs, are presented in Figures 11, 12, 13, and 14, and Table 6.

Four flow measurements were taken along the West Palm Beach Canal:

1. 1330 - May 29 at the downstream site of S-155 by the U.S.G.S., total discharge was estimated to be 3600 cfs at a stage of 7.50 ft, three gates were open full.
2. 1430 - May 29 at Blue Trace Bridge by the District, total discharge was estimated to be 726 cfs.
3. 1500 - May 29 at Wellington Bridge, total discharge was estimated to be 1473 cfs at the stage of 15.05 ft NGVD.

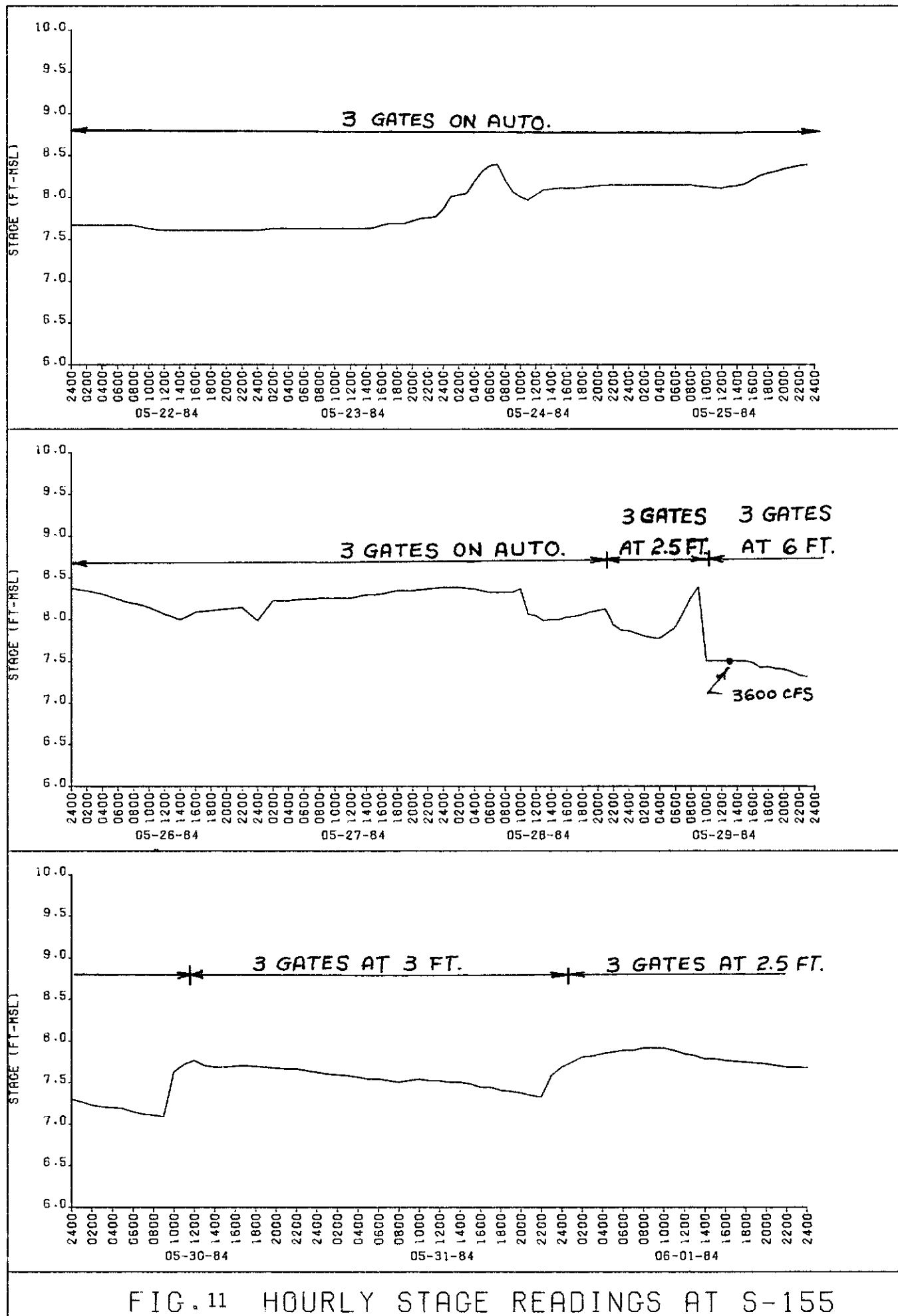
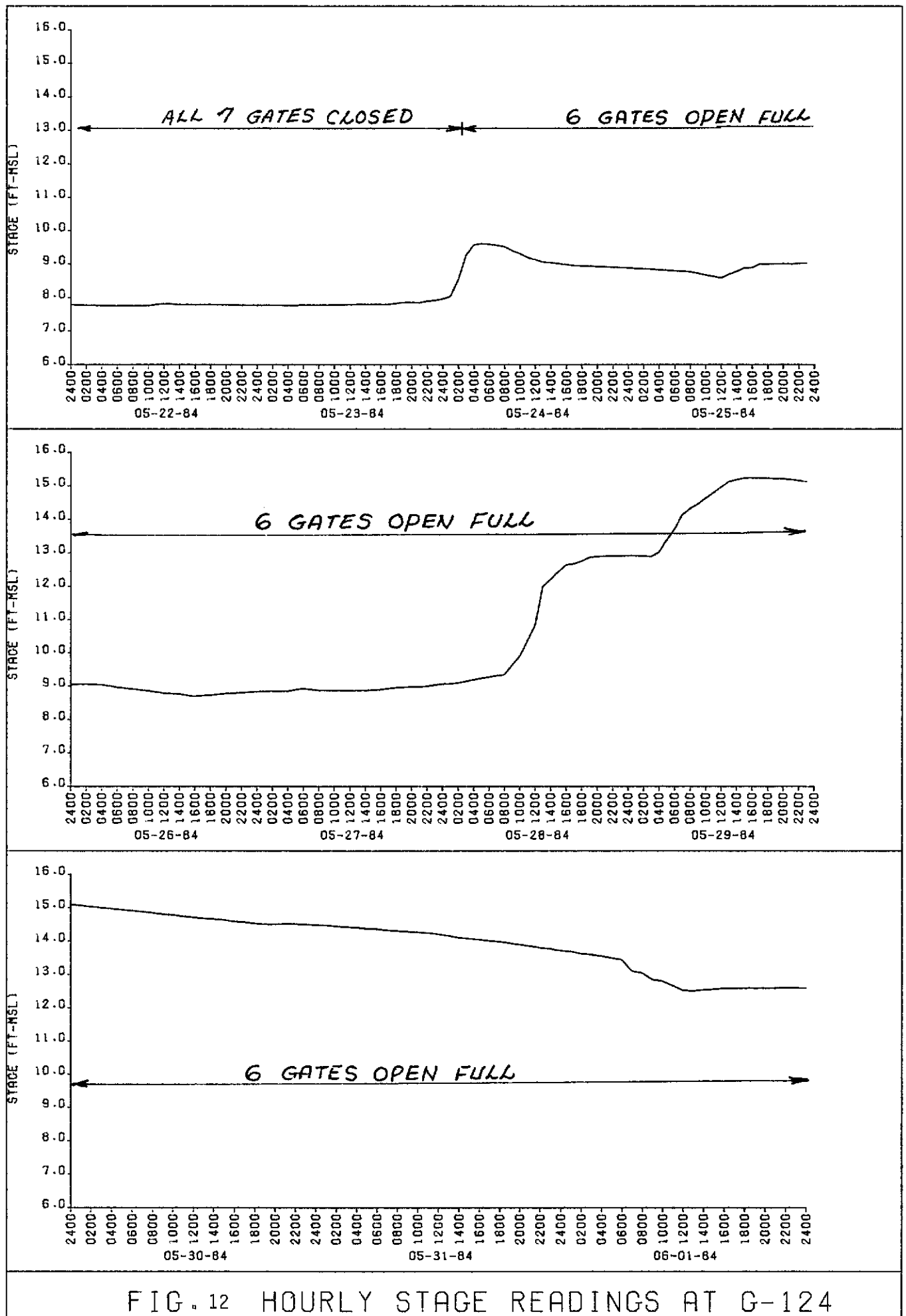


FIG. 11 HOURLY STAGE READINGS AT S-155





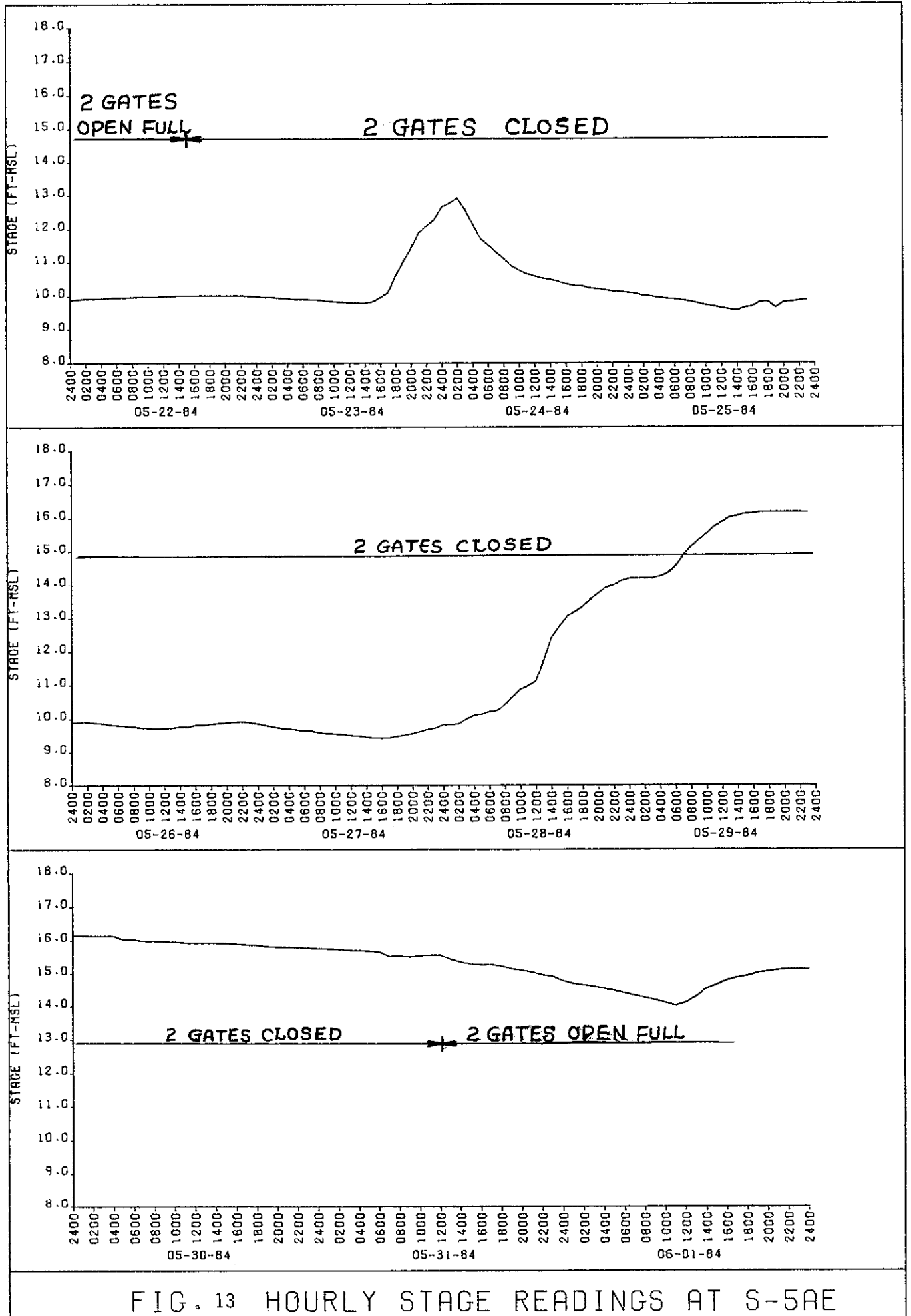


FIG. 13 HOURLY STAGE READINGS AT S-5AE

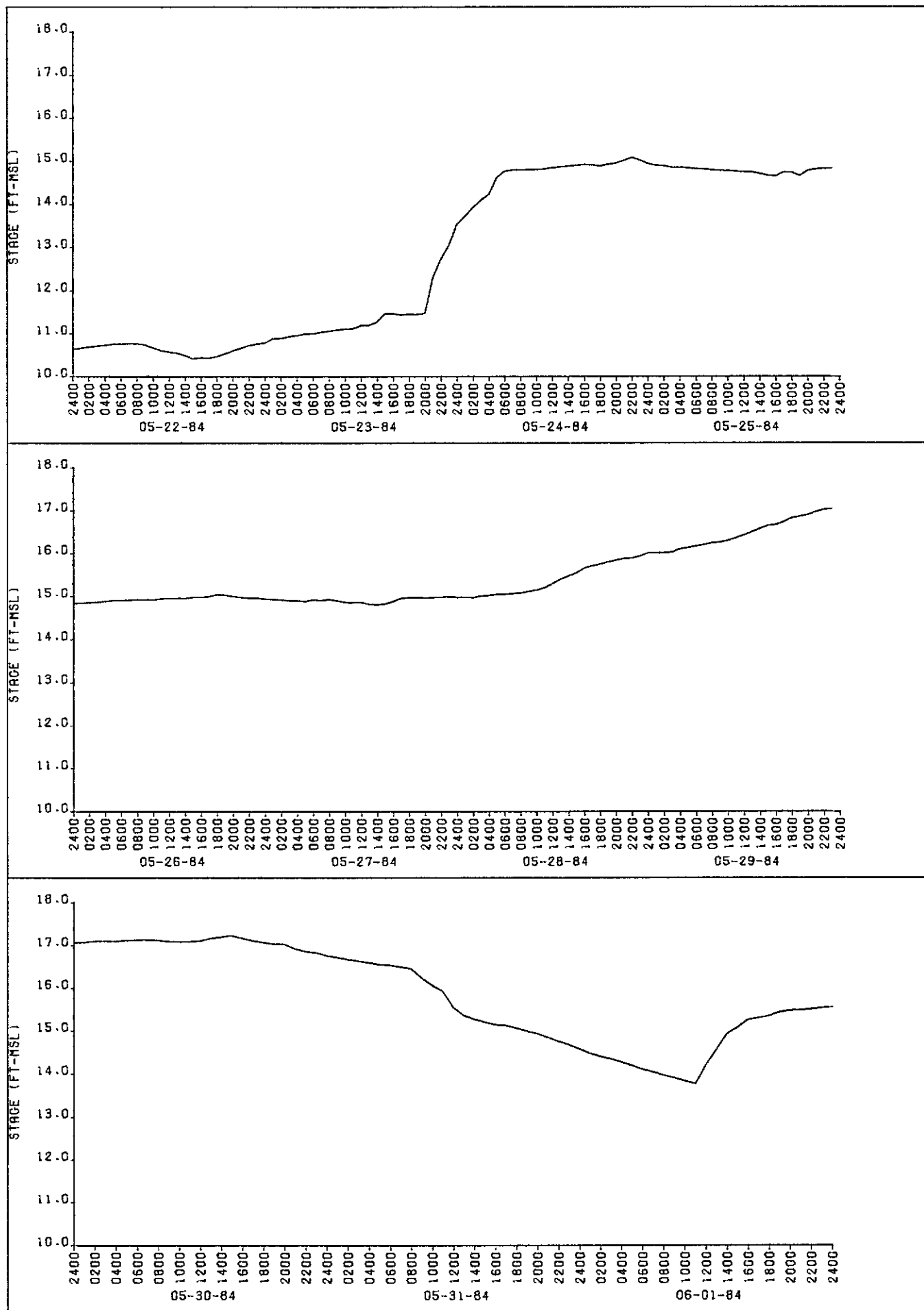


FIG. 14 HOURLY STAGE READINGS AT L-8

4. 1030 - May 30 at outfall spillway of the E-1 canal, total discharge was about 358 cfs.

TABLE 6  
COMPILATION OF SYSTEM OPERATION IN THE PALM BEACH AREA

<u>Structure</u>	<u>Location</u>	<u>Mode of Operation</u>	<u>Structure Operated</u>		<u>Remarks</u>
			<u>Time</u>	<u>Date</u>	
S-5A	L-12	-	-	-	Pumps in operation
S-6	L-15	-	-	-	Pumps in operation
S-7	L-18	-	-	-	Pumps in operation
S-8	L-23	-	-	-	Pumps in operation
S-2	L-14				Pumps in operation
S-3	L-25				Pumps in operation
S-40	C-15	Automatic	1100	5/28/84	H.W. stage lowered to 7.0 ft NGVD
S-41	C-16	Automatic	1200	5/28/84	H.W. stage lowered to 7.0 ft NGVD
S-44	C-17	Automatic	1200	5/28/84	H.W. stage lowered to 6.0 ft NGVD
S-46	C-18	Automatic	1300	5/30/84	Reset auto setting from dry to wet
S-5AE	C-51	Manual	1200	5/31/84	Open full
S-5AW	C-51	Manual	0900	5/31/84	Open full
G-124	C-51	Manual	1030	5/28/84	Open full
S-155	C-51	Automatic	1000	5/28/84	H.W. stage lowered to 7.5 ft NGVD

#### IV. Ft. Lauderdale Area

In response to heavy rainfall, canal stages were lowered to facilitate the secondary drainage system. Due to the system capacity limitations, some western parts of the canals still experienced high stages.

Figure 15 presents the hourly stage hydrograph with gate operations during the rainstorm at S-36 headwater. Figures 16 and 17 show the hourly stage hydrographs of the tailwater and headwater of S-13A near Cooper City.

TABLE 7  
COMPILATION OF SYSTEM OPERATION IN THE FT. LAUDERDALE AREA

<u>Structure</u>	<u>Location</u>	<u>Mode of Operation</u>	<u>Structure Operated</u>		<u>Remarks</u>
			<u>Time</u>	<u>Date</u>	
S-9	C-11	-	-	-	Pump in operation
S-13	C-11	Automatic	-	-	Pump in operation
S-36	C-13	Automatic	1000	5/28/84	Open gates to lower stage
G-54	North New River	Manual	0900	5/28/84	Open full
G-56	Hillsboro Canal	Automatic	0900	5/28/84	Open full

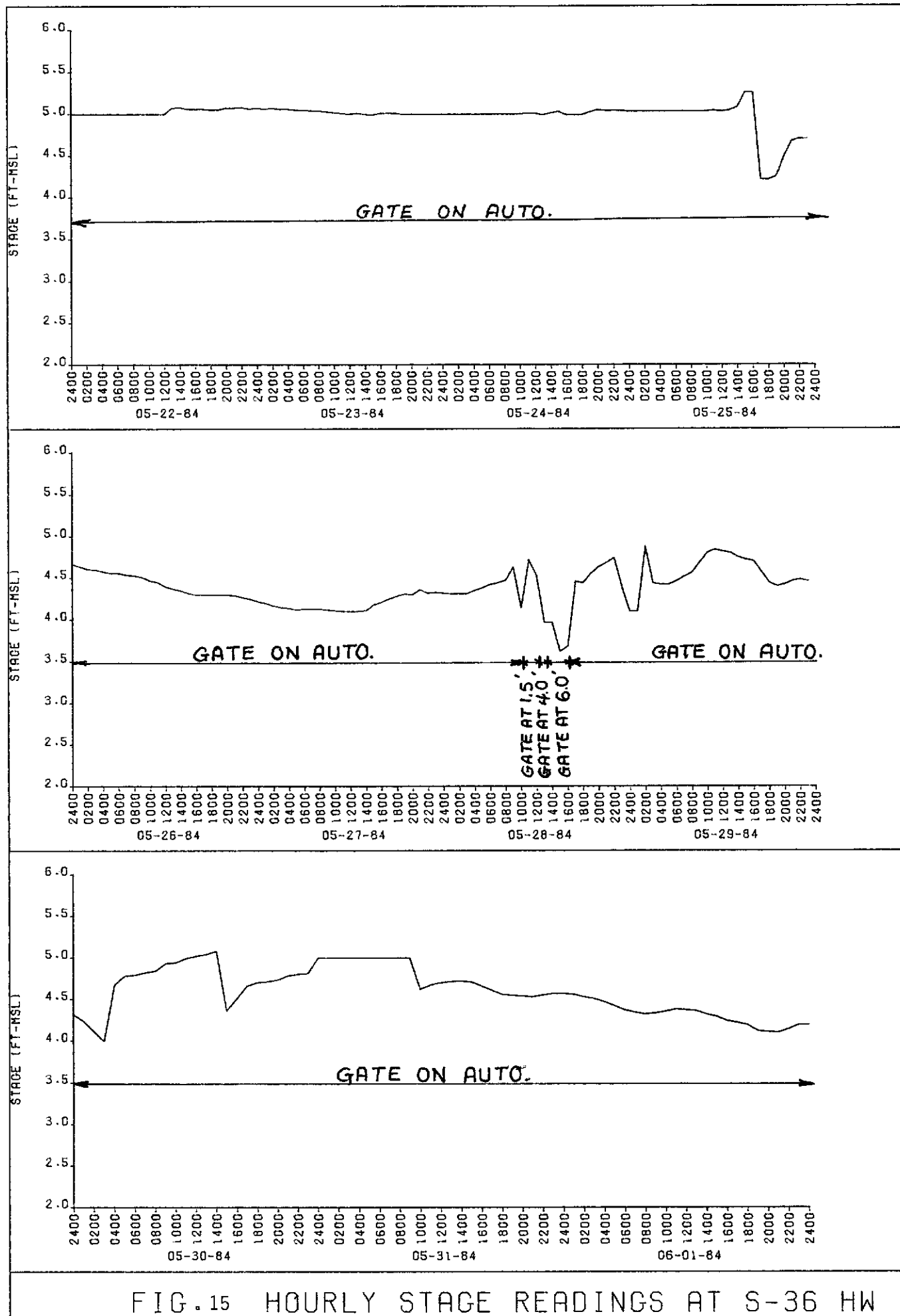


FIG. 15 HOURLY STAGE READINGS AT S-36 HW

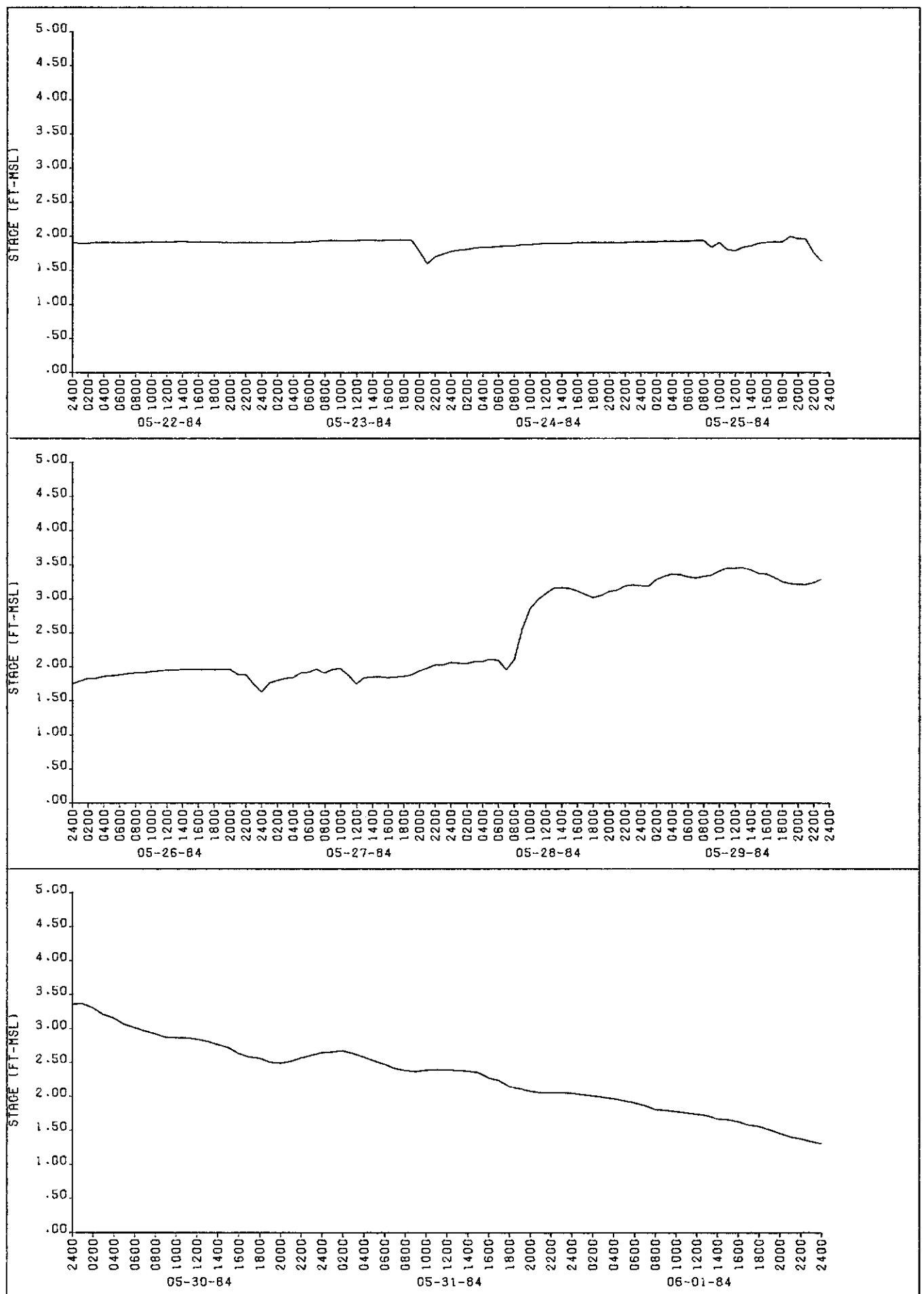


FIG. 16 HOURLY STAGE READINGS AT S-13A TW

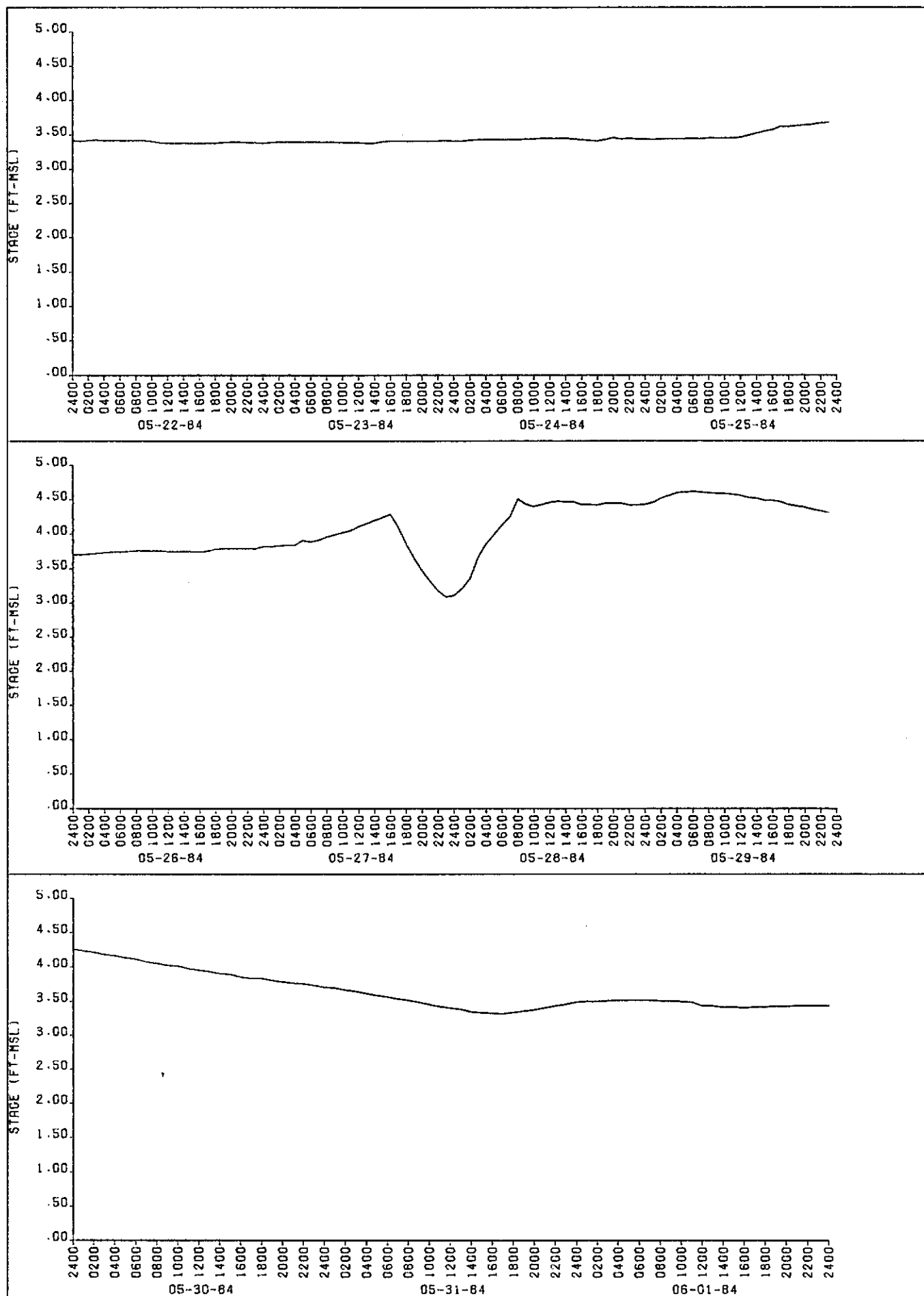


FIG. 17 HOURLY STAGE READINGS AT S-13A HW

## FIELD INSPECTION OF AFFECTED AREAS

Field inspections were conducted in known flood prone areas and as a result of complaints from District residents. The majority of complaints and inquiries were generated from the southwest Palm Beach County area (Lake Worth to Boca Raton). The nature of these inquiries and complaints revolved around lot and road flooding. Complaints of house flooding were not received at the Palm Beach office. A total of 34 inspections out of 61 resulted from these complaints.

### Jupiter-Eastern Basin (Figure 18)

The Town of Jupiter was inspected during the morning of May 29. Street and minor lot flooding in parts of the town were reported by the District field representative. This flooding was due, in part, to the incomplete status of a permitted water management system, Permit #50-01105-S. With the exception of minor ponding, water levels returned to normal within 24 hours. Damages were limited to minor road washouts.

### Jupiter-Western Basin (Figure 19)

Jupiter Farms, a rural housing development within this basin, was inspected May 29. This area has drainage provided by the South Indian River Water Control District. Residents within Jupiter Farms experienced road flooding and lot inundation of short duration. Road and lot flooding was limited to an inconvenience level. House flooding was not reported or observed.

### Royal Palm Beach (Figure 20)

The Royal Palm Beach development is located north of C-51, south of SR 710, west of SR 7, and east of the L-8 canal, and encompasses an area of approximately 29 square miles. Development in this area ranges from standard housing and multi-unit subdivisions to 1-acre plus, rural residential units with unpaved roads. Royal Palm Beach's drainage is provided by the



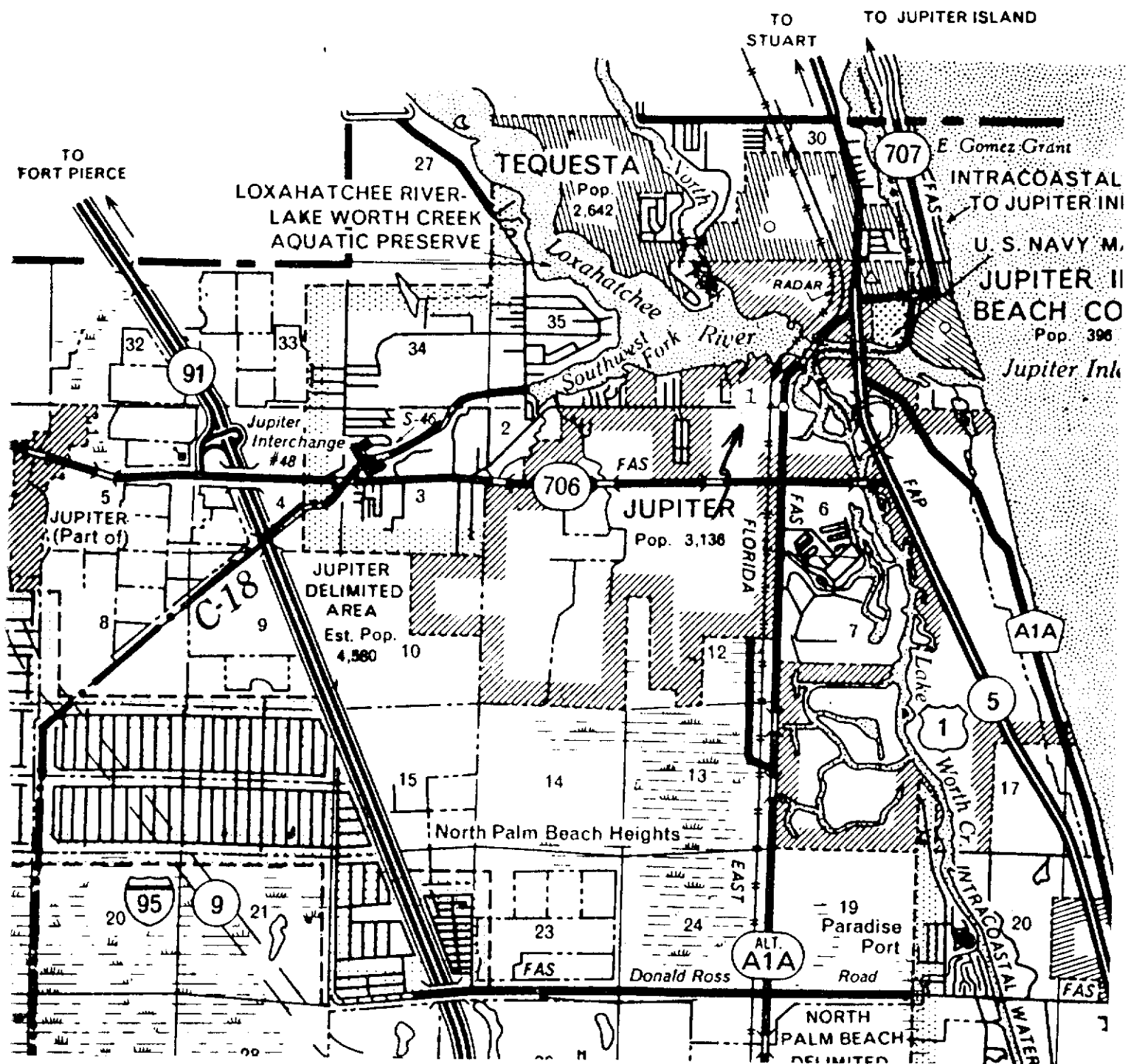


FIGURE 18  
Jupiter-Eastern Basin

1) Area of street flooding due to inoperable surface water management system.

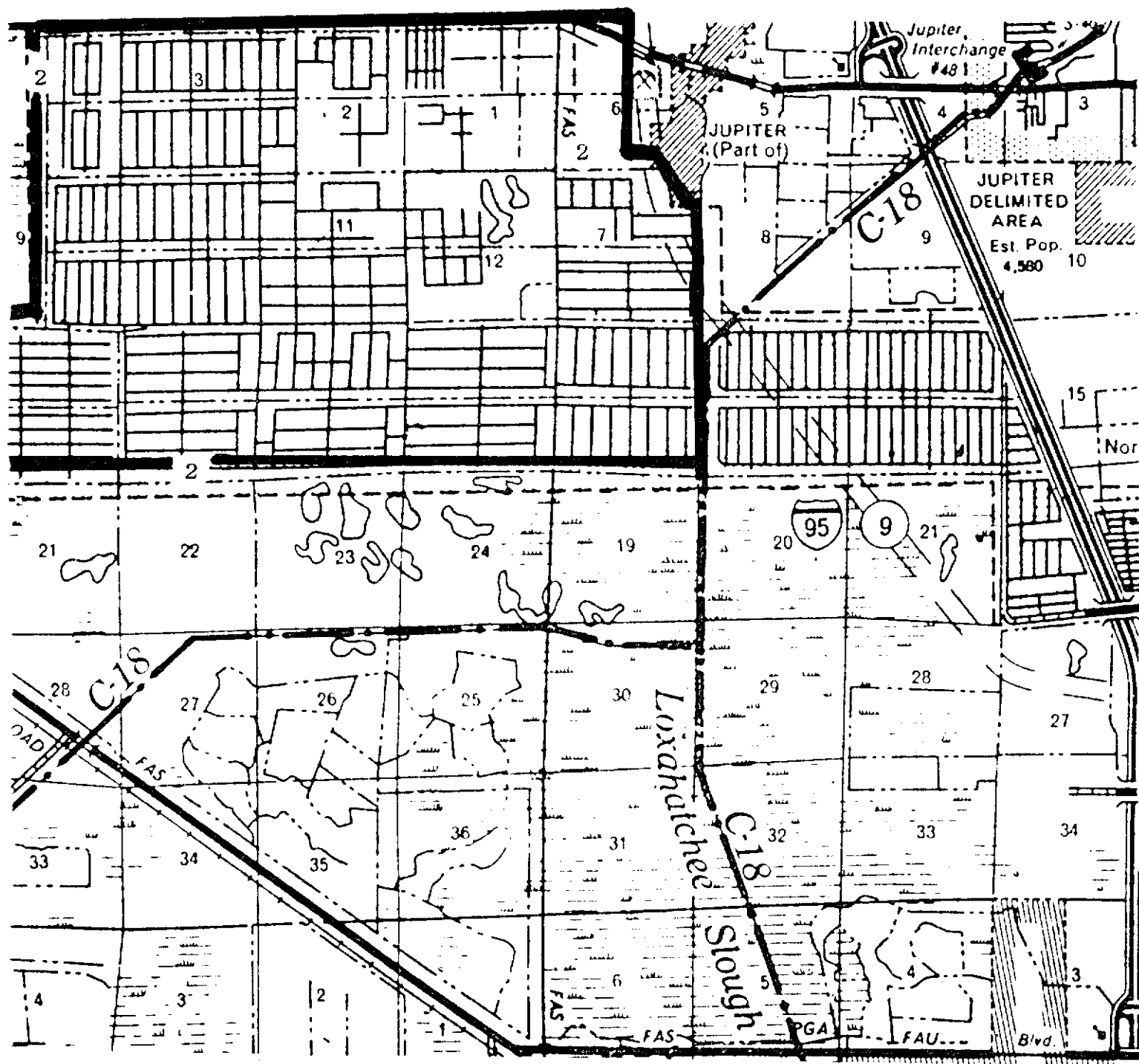


FIGURE 19  
Jupiter-West Basin

2) Outline of the area known as Jupiter Farms.

This area had road and minor lot flooding of a short duration.

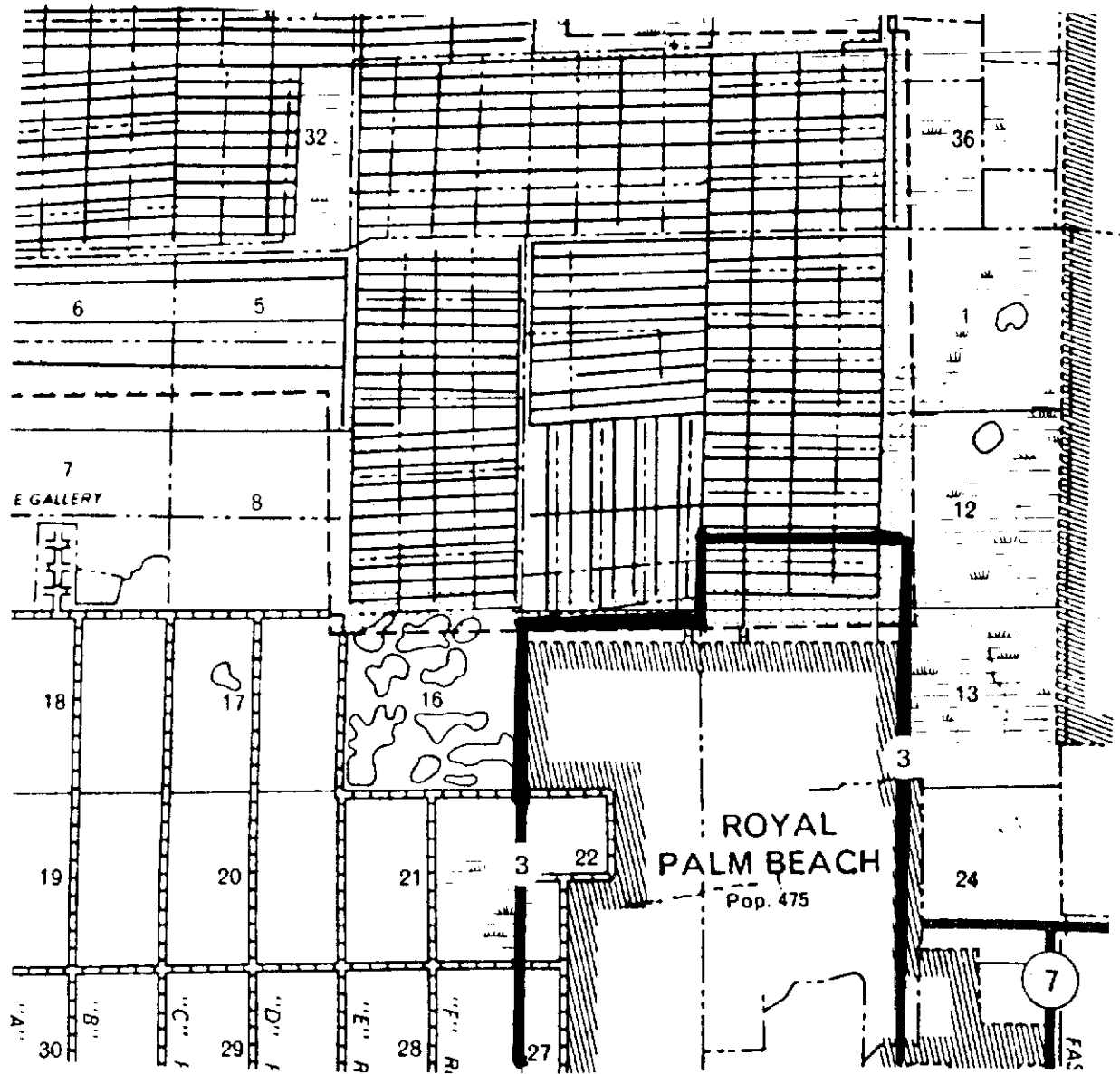


FIGURE 20  
Royal Palm Beach

- 3) Outline of the Royal Palm Beach area inspected May 29, 1984.  
Minor road flooding was observed by staff.

Indian Trail Water Control District with major outfall to the C-51 and the M-1 canals.

Inspection of this area on May 30 revealed moderate road flooding with water in swales and low parcels. Interior canals were observed to be at capacity. Structural flooding did not occur and damages were confined to isolated minor road washouts and canal erosion.

The Lone Pine housing development, Permit #50-00449-S, was inspected on May 30. This area has historically experienced street and swale flooding during excessive rain events; however, this inspection revealed no such flooding. The project is serviced by the North Palm Beach Water Control District and discharges to the EPB-9 and -10 canals. At the time of inspection these canals were at approximately 75 percent of capacity.

The Gardens of Woodberry, Permit #50-00622-S, was also inspected on May 30. This project off of PGA Boulevard had no street or standing water problems at the time of inspection. The interior lake system was full and discharge was via a bleeder slot in the 36 inch riser.

#### Wellington-Greenacres Area (Figures 21 & 22)

On the morning of May 29 field inspections were conducted in Wellington, Palm Beach Ranchetts, Cypress Trails, Mead Racket Club/Willow Bend, Holiday at Lantana, Homeland, and Garden Hills and Garden Lakes.

1. Wellington is a land development project which encompasses approximately 15 sections and is located west of SR 7, south of C-51, and north of Lake Worth Road. Wellington has drainage provided via a permitted surface water management system, Permit #50-00548-S. All interior canals were observed to be within 1 ft of the top of the bank. Street flooding was predominant in the west-central areas of the development. Structural flooding was not reported or observed. At the time of inspection, levels

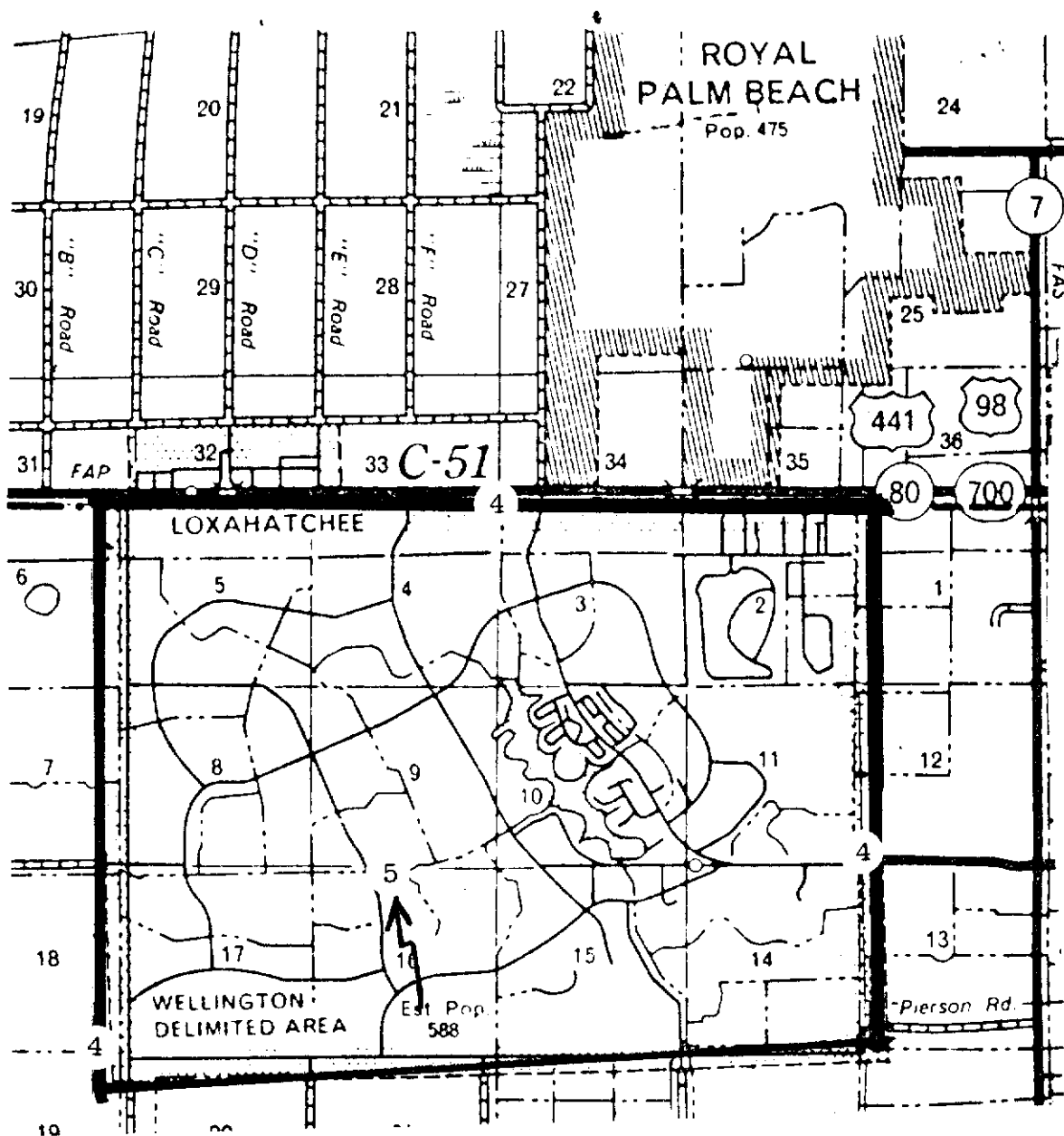


FIGURE 21  
Wellington

- 4) Outline of the Wellington area.
- 5) Area of observed road flooding.

FIGURE 22.

within the development's interior canals as well as C-51 had not yet peaked.

2. Complaints were received from, and inspections made at, Palm Beach Ranchettes. This unpermitted development is in the better part of two sections located west of the Florida Turnpike, one mile north of Lake Worth Road, and east of SR 7. Drainage is provided via unmaintained lateral ditches outfalling to canals of the Lake Worth Drainage District. Palm Beach Ranchettes experienced road flooding throughout the development. Lot flooding was moderate and older low-lying homes had waters near the first floor elevations.
3. Cypress Trails, Permit #50-00795-S, is located at Lake Worth Road and SR 7. Road flooding was not observed and only minor swale inundation occurred.
4. The Mead Racket Club/Willow Bend development, Permit #50-00631-S, has drainage discharges to Lake Worth Drainage District laterals L-11 and E-2. Both canals were at or near the top of their banks. Road and swale flooding was widespread with the greatest problems near the drop inlets.
5. Holiday at Lantana, Permits #50-01109-S and #50-00567-S, is a single-family housing development just east of the Florida Turnpike off Lantana Road. This project drains into the Lake Worth Drainage District E-2 canal. At the time of the May 29 inspection, water in E-2 was at or near its banks and street and swale flooding was observed at all drop inlets of the project.
6. Homeland, Permit #50-00466S, is located west of SR 7, approximately 1 mile south of Lake Worth Road. This area is a development of 1 to 5 acre parcels in low-lying lands; cypress is quite common here. At the time of the inspection on May 29, lot and road flooding was observed.

Water from the Lake Worth Drainage District outfall canal was observed to be flowing into the Homeland system. While some lot flooding was extensive, structural flooding was not observed.

7. Garden Hills and Garden Lakes, Permits #50-00998-S and 80-128, are single-and multi-family developments off Forest Hill Boulevard, one-half mile west of Military Trail. Water was observed in swale systems and minor road flooding was apparent.

#### **West Boca Raton (Figure 23)**

The west Boca Raton area, primarily the area of Clint Moore Road, west of the Florida Turnpike and north of Glades Road, was inspected in the afternoon on May 29, at the conclusion of the rain event. The following projects were inspected.

1. The Spanish Isles development, Permit #50-00463-S, is one-half mile north of Clint Moore Road west of Lyons Road. Water from this area is drained to canals of the Lake Worth Drainage District. At the time of inspection, water within the LWDD canals near drop inlets, the system appeared open with drainage being restricted due to high receiving water elevations. Water did not reach house pad elevations, however, the peak stage was within 2 ft of some house pads.
2. A development one mile south of Clint Moore Road, east of SR 7 and west of the Turnpike was observed to have flooding, partially as a result of a malfunctioning water management system. This area, developed by American Homes, is drained by a surface water management system, Permit 50-00403-S which outfalls to the LWDD E-1 canal. Extensive street and swale flooding was observed east of the E-1 canal and north of New England Boulevard. Levels in E-1 and the system's lake were measured and it was determined that flows from the lake system were blocked at the outfall



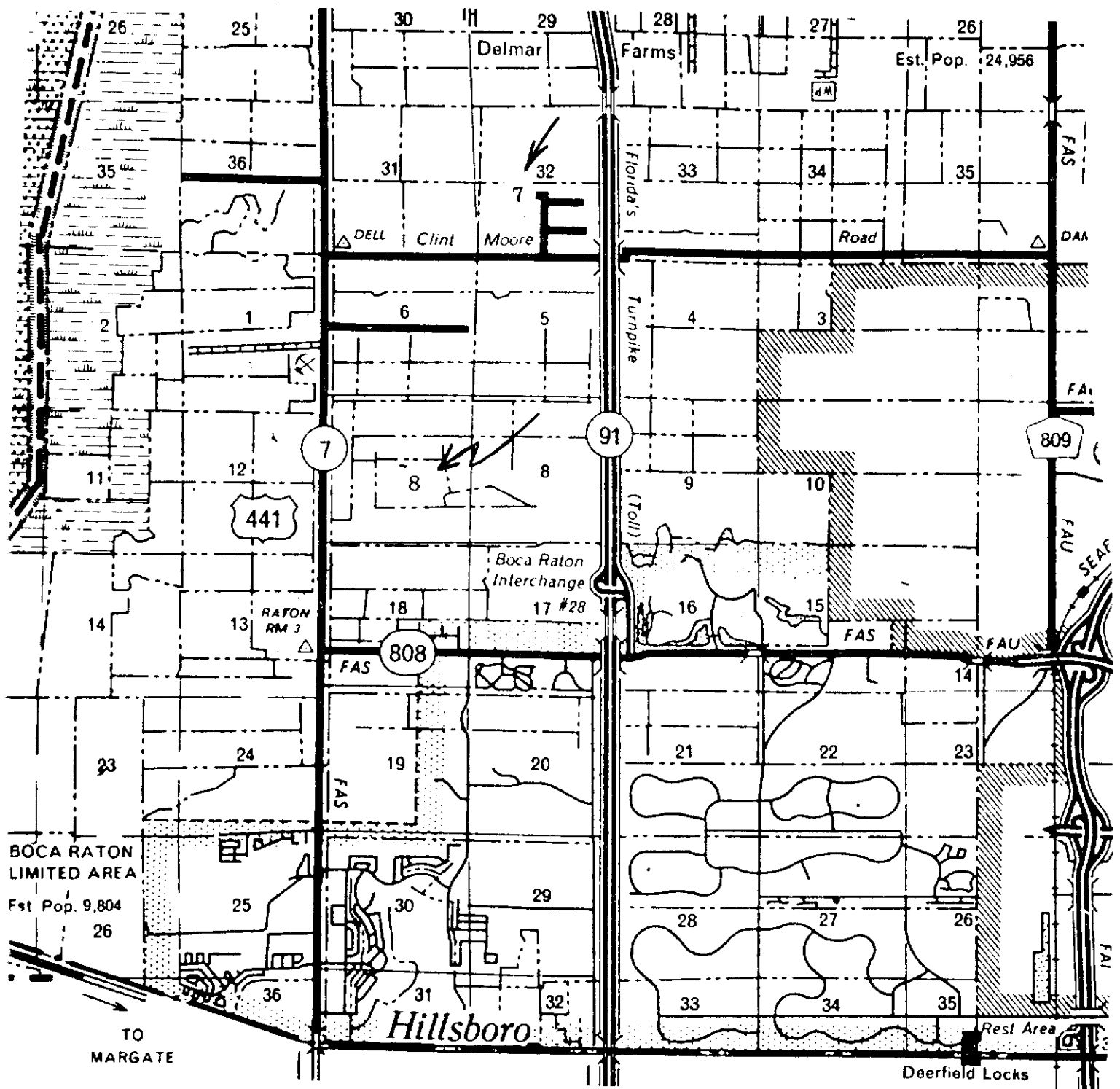


FIGURE 23  
West Boca Raton

- 7) Spanish Isles - experienced road and swale flooding.
- 8) American Homes - observed apparent blockage of outfall structure.

structure. This structure was under 2 inches of water and the nature of the blockage was undetermined at the time of inspection. The area east of the E-1 and south of New England Boulevard (Century Village) was also experiencing road flooding at most drop inlets via the drainage structure to the roads.

### **Broward County**

Parts of Broward County experienced road, swale, and lot flooding; however, complaints from this area were few. Lincoln Park, Permit #06-00501-S, was inspected May 29. This project is located in the City of Pompano Beach and drains into C-14. Water from this project reached the stage level of C-14 and thus drainage was limited by the rate of discharge from C-14. Little flooding was observed as a result of this limited discharge.

### **Miami-Dade**

Flooding in Dade County reportedly caused more serious structural damage than in Palm Beach County. News media reports and reports from field inspectors revealed flooding of trailer parks (Figure 24), and single- and multi-family units. Specific information was not available at the time of this writing. Flooding of residential areas occurred in older, pre-permit developments of Miami. Field representatives did not find serious flooding in areas serviced by approved and permitted water management systems.

### **Observed Surface Water Quality Violations**

Aerial inspections of Palm Beach County on May 30 revealed water quality violations from construction dewatering.

It was concluded that the observed violations were a result of: 1) failure of the contractors to prepare for, or anticipate the impact of, a rainfall event in excess of the norm, 2) contractors building earthen

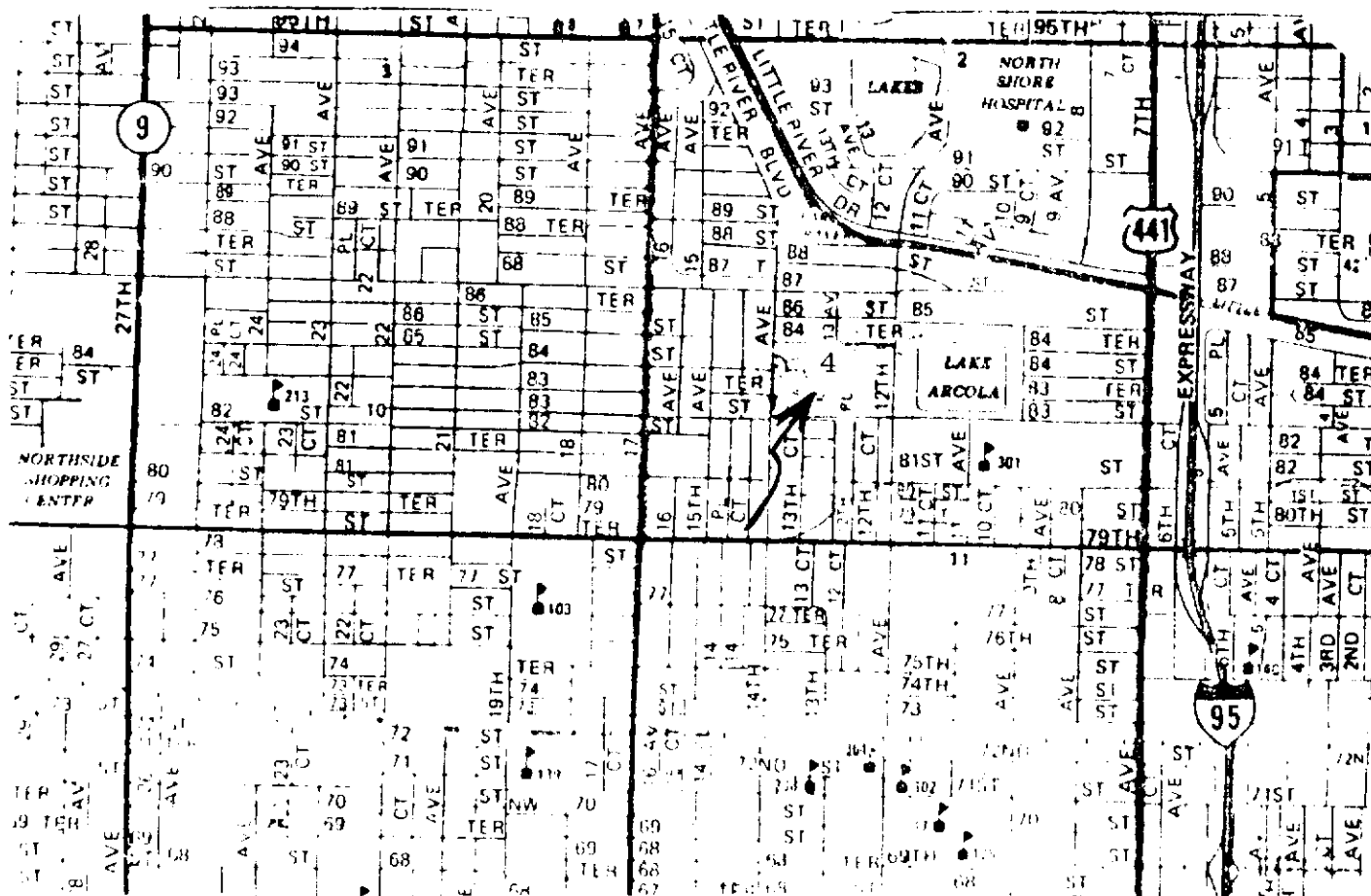


FIGURE 24  
Miami-Dade Area

4) Flooding observed in the Lake Arcola area.

retaining berms with unsuitable materials, 3) failure of the contractors to cease pumping, further aggravating the already saturated conditions, and 4) failure of turbidity curtains to adequately treat the turbid water discharge.

## SUMMARY OF THE RAINFALL EVENT

This rainstorm of May 22-31, 1984, was basically caused by two sequences of cold front activities associated with continuous moist tropical air movement over the State of Florida as a high pressure system in the Atlantic Ocean moved eastward. An upper air disturbance in the Gulf of Mexico moving northeast across Florida was responsible for heavy showers and thunderstorms in the lower east coast of Florida.

Even though this rainstorm was not very severe, several areas were flooded and the West Palm Beach canal overflowed its bank at an area approximately 0.9 miles east of the S-5A pumping station. A strip of land along the Florida Turnpike west of Boynton Beach, Delray Beach, and Boca Raton received the highest rainfall amount of 14.0 to 18.0 inches. The area east of Water Conservation Area 1 and the eastern half of Water Conservation Area 2A received over 10.0 inches of rainfall during this ten day period. The western C-51 basin received 10.0 to 12.0 inches of total rainfall in this 10-day period. Ft. Lauderdale and North Miami Beach received approximately the same amount of rainfall. The rest of the District's area received much less rainfall than the areas mentioned.

A five day rainfall distribution over the lower east coast area was delineated based on the available information at this time. The distribution pattern is similar to the one based on the entire rainfall amount from this event.

The highest rainfall area, along the Florida Turnpike west of Delray Beach and Boca Raton, received 12.0 to 14.48 inches which is equivalent to 1 in 10 years 5-day rainfall for the area.

The western C-51 basin received 7.0 to 9.6 inches in the 5-day period

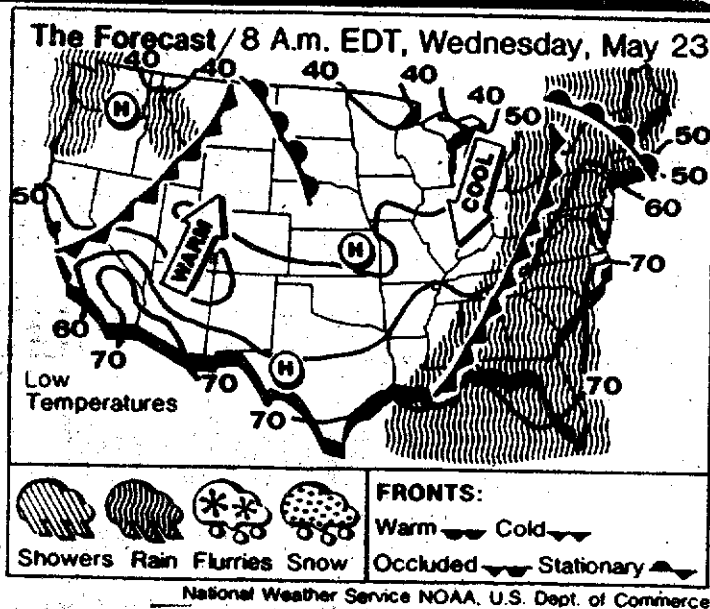
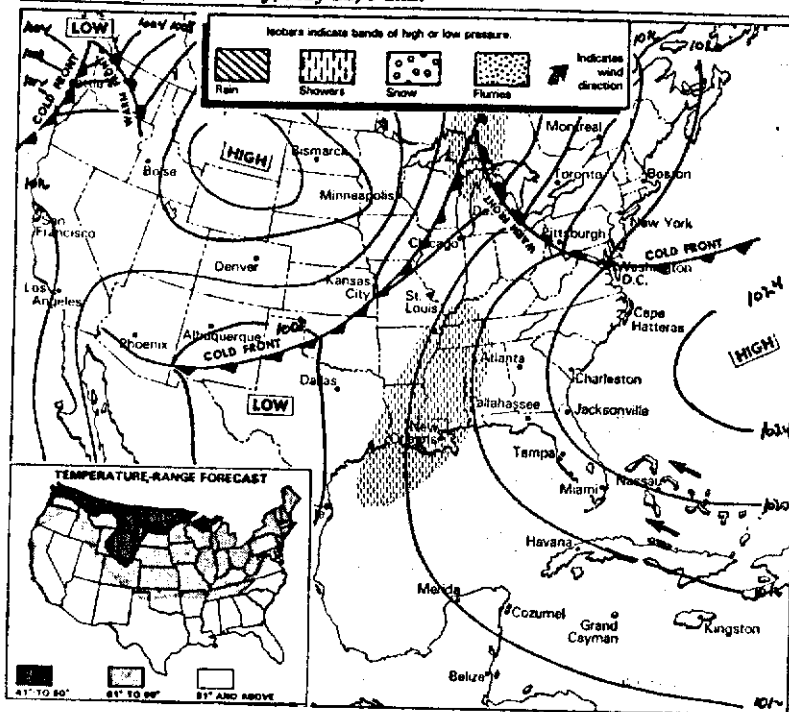
which is equivalent to a 1 in 3 to 5 years return period. Loxahatchee, Wellington and Royal Palm Village received 8.0 to 9.6 inches which is equivalent to one in 5 years return period. Eastern C-51 basin received 6.0 to 9.0 inches of rainfall in a 5-day period which is equivalent to 1 in 3 years or less return frequency.

A comparison of this rainstorm and the October 22-24, 1983 rainstorm indicated that the intensity and volume of rainfall at Loxahatchee was slightly less than the October 22-24, 1983 storm. However, the rainfall amount in the L-8 basin and East Everglades Agricultural Area (EAA) were twice the amount of rainfall than in October 22-24, 1983. Pumping station S-5A can only drain the runoff from the EAA; therefore, the water levels in the L-8 borrow canal were much higher than the October 22-24, 1983 storm. The water level in the L-8 canal did not begin to recede until May 31, 1984 after the S-5A(W) and S-5A(E) were opened and pumped by the S-5A pumps.

A review of the operation data from Homestead, Miami, Ft. Lauderdale, and the West Palm Beach areas indicated that the systems were operated properly. The capacity of the West Palm Beach Canal in a reach between SR-7 and S-5A(E) and L-8 canal was overloaded again with a rainstorm equivalent to a 1 in 5 years return period. Evidently there is an urgent need to implement the M-1 canal project in Royal Palm Beach Estate and the water management plans for the western C-51 basin proposed by the District in March 1984.

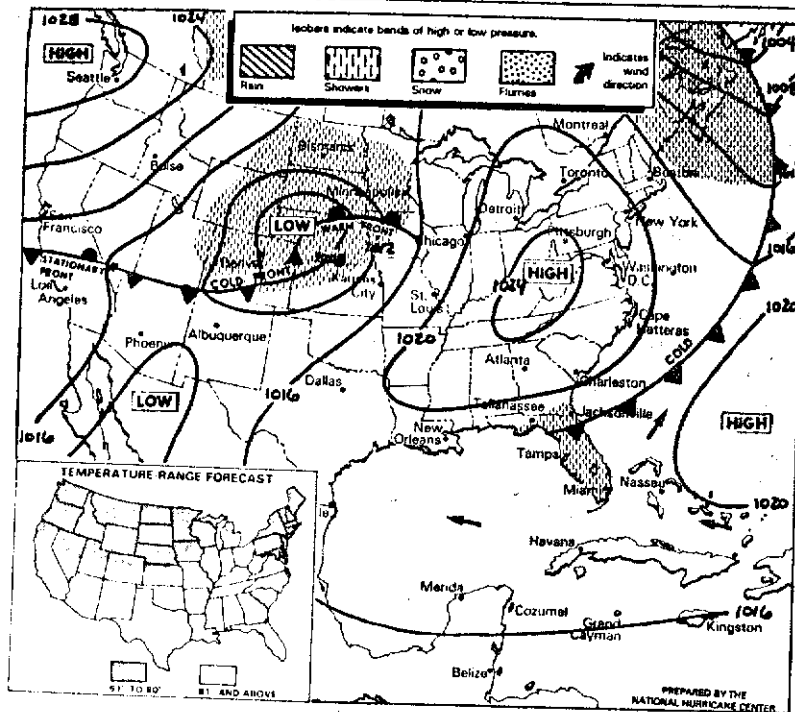
# APPENDIX A - WEATHER MAPS\*

Forecast map for Tuesday, May 22, 7 a.m.

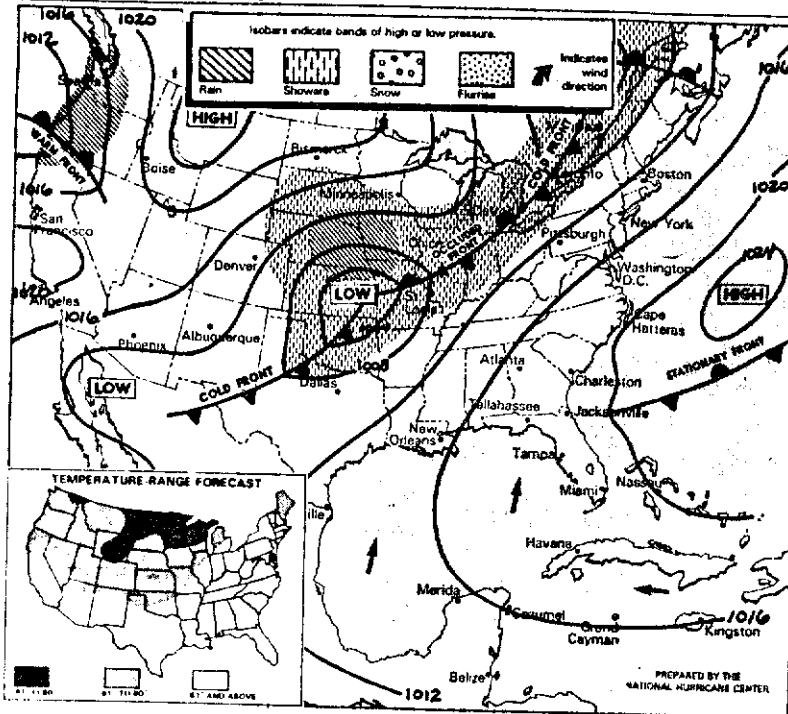


\*Copied from local newspapers.

Forecast map for Thursday, May 24, 7 a.m

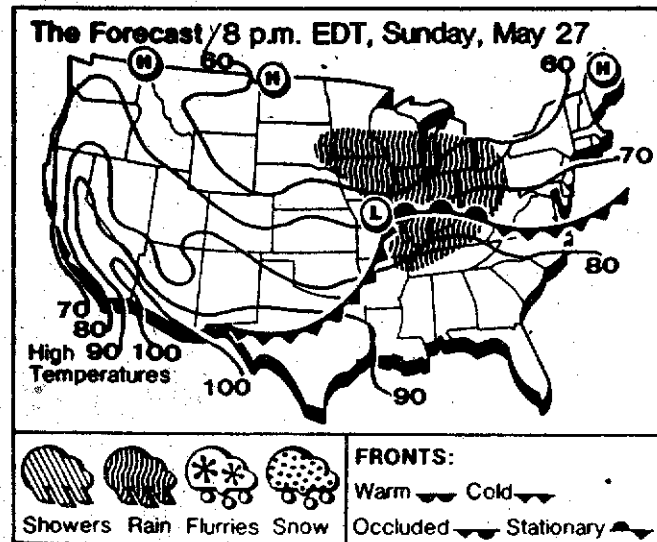
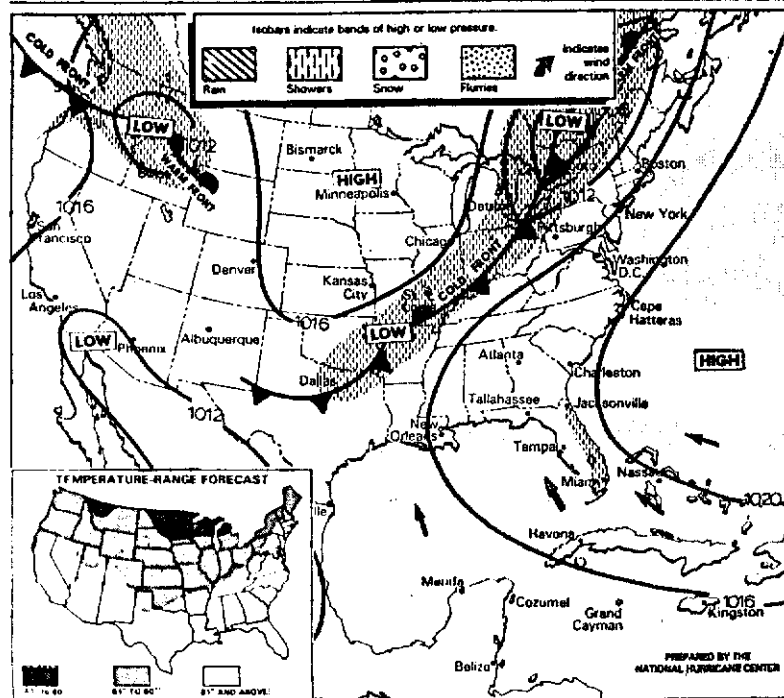


Forecast map for Fri, May 25, 7 a.m.



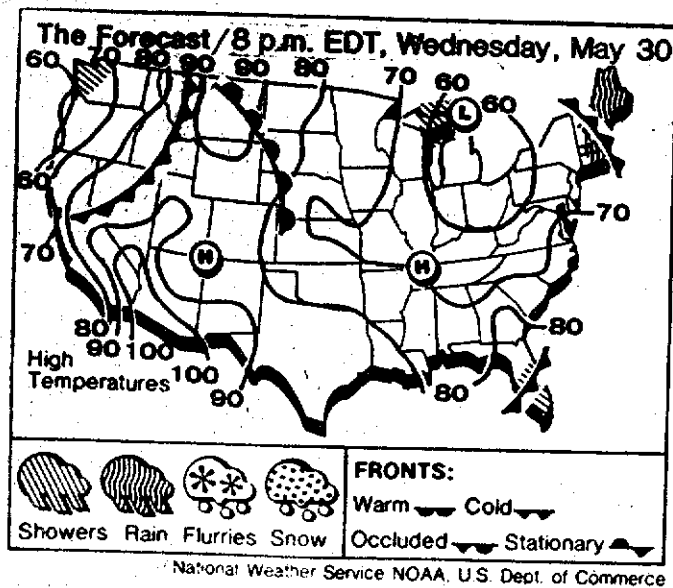
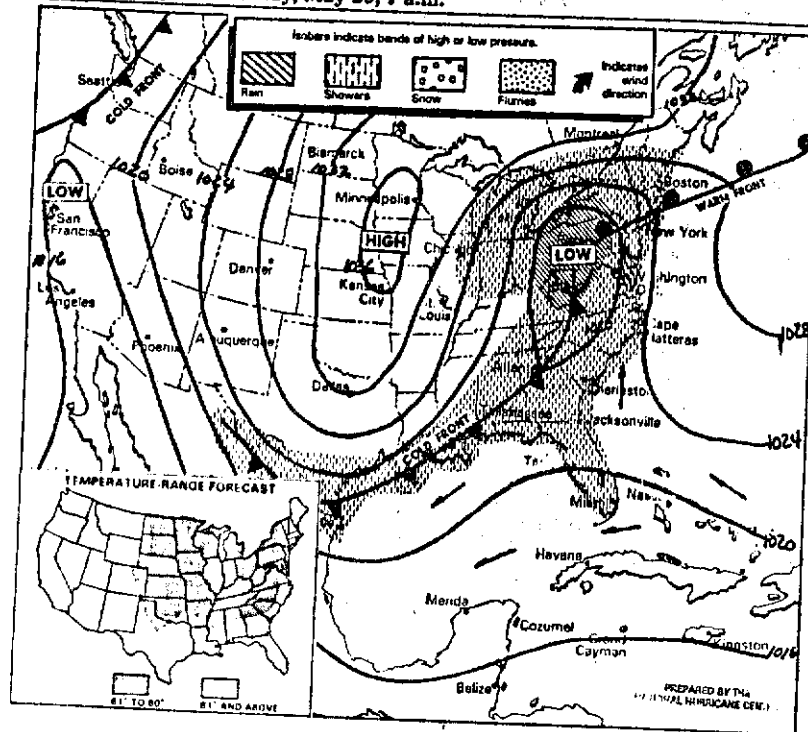


Forecast map for Saturday, May 26, 7 a.m.



National Weather Service NOAA, U.S. Dept. of Commerce

Forecast map for Tuesday, May 29, 7 a.m.



## APPENDIX B

The following tables present periods of 10-day rainfall exceeding 10 inches as compared to the current event:

### A. Loxahatchee (1941-1984)

<u>Periods</u>	<u>Rainfall-Inches</u>	<u>Remarks</u>
Sept. 15-24, 1941	14.54	
Sept. 14-23, 1948	14.01	
Oct. 10-19, 1950	12.56	
Sept. 15-24, 1953	10.39	
June 14-23, 1959	15.88	No rain in last 3 days
Oct. 16-25, 1959	13.04	
Sept. 17-26, 1960	18.06	
June 30-July 9, 1967	11.55	
June 11-20, 1969	10.55	
Aug. 28-Sept. 6, 1977	13.45	
Sept. 8-17, 1979	11.20	
Aug. 15-24, 1981	10.64	
Oct. 16-25, 1983	12.11	(8.8" on Oct. 22-23)
May 22-31, 1984	10.21	(7.54" on May 28-29)

Evidentially, this rainfall event was not unusual at Loxahatchee.

### B. Palm Beach International Airport (1939-84)

<u>Periods</u>	<u>Rainfall-Inches</u>	<u>Remarks</u>
July 5-14, 1941	12.42	
Sept. 14-23, 1941	12.83	
May 27-June 5, 1942	13.28	
June 1-10, 1942	10.98	
June 19-28, 1945	11.16	(9.29" on June 23-24)
Aug. 27-Sept. 5, 1946	10.35	
June 10-19, 1947	11.10	
Oct. 9-18, 1947	10.20	(8.85" on Oct. 11-12)
Sept. 20-29, 1948	10.80	
Oct. 15-24, 1959	11.19	(9.04" on Sept. 20-22)
Sept. 17-26, 1960	15.18	
Oct. 13-22, 1965	12.52	
May 26-June 4, 1968	12.07	
Sept. 25-Oct. 4, 1968	13.17	
Aug. 28-Sept. 6, 1977	11.84	
Sept. 8-17, 1979	11.33	
Nov. 1-10, 1982	11.89	Major rainfall on Nov. 1&8
May 22-31, 1984	8.44	

## APPENDIX B (Continued)

### C. FORT LAUDERDALE (1914-84)

<u>Periods</u>	<u>Rainfall-Inches</u>	<u>Remarks</u>
July 25-Aug. 5, 1915	11.25	
Oct. 22-31, 1915	11.48	
May 29-June 7, 1919	10.84	(No rain on June 6-7)
Oct. 15-24, 1921	19.55	(Oct. 1921 total at 31.34")
Oct. 16-25, 1924	22.75	(Oct. 1924 total at 32.10")
Aug. 5-14, 1928	10.63	
Oct. 6-15, 1929	13.31	
May 28-June 6, 1930	15.84	(No rain on June 4-6)
Sept. 6-15, 1931	10.98	
Aug. 15-24, 1933	13.10	
May 13-22, 1934	10.23	
June 11-20, 1936	11.39	(9.62" on June 14-15)
June 10-19, 1947	12.10	
Oct. 4-13, 1947	19.25	(10.85" on Oct. 12)
June 13-22, 1959	10.60	
June 1-10, 1966	13.17	
June 11-20, 1967	13.09	
Oct. 2-11, 1967	10.55	
Nov. 14-23, 1973	10.89	(10.45" on Nov. 20)
Aug. 16-25, 1976	10.84	
June 1-10, 1977	11.63	
Apr. 24-May 3, 1979	19.78	(14.59" on Apr. 25)
Oct. 8-17, 1980	10.11	
May 24-June 3, 1982	12.26	
June 17-26, 1982	10.35	
May 22-31, 1984	10.22	

### D. MIAMI INTERNATIONAL AIRPORT (1948-84)

<u>Periods</u>	<u>Rainfall-Inches</u>	<u>Remarks</u>
Sept. 13-22, 1948	16.36	
May 22-31, 1958	12.04	
June 12-21, 1959	13.51	
Nov. 17-26, 1959	10.37	
Sept. 2-11, 1960	13.67	
June 1-10, 1966	10.67	
Sept. 26-Oct. 5, 1967	10.25	
June 2-11, 1968	10.65	
May 23-June 1, 1970	10.83	
May 4-13, 1977	14.38	
Apr. 24-May 3, 1979	18.09	(16.24" on Apr. 24-25)
May 22-31, 1984	9.36	